

**Army and Air Force Exchange Service**

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**REVISED FINAL  
ENVIRONMENTAL REVIEW  
FOR  
THE CONSTRUCTION OF A NEW BASE  
EXCHANGE**

**KADENA AIR BASE, OKINAWA, JAPAN**



**MAY 2007**

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**Submitted to:**

**Army and Air Force Exchange Service (AAFES)**

**MAY 2007**





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## LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

$\mu\text{m}^3$	Micrograms per Cubic Meter
III MEF	III Marine Expeditionary Force
18 AMDS/SGPG	18 <sup>th</sup> Civil Engineer Squadron, Bioenvironmental Engineering Flight
718 CES/CEV	718 <sup>th</sup> Civil Engineer Squadron, Environmental Flight
AAFES	Army and Air Force Exchange Service
AB	Air Base
ACAM	Air Conformity Applicability Model
AEI	Air Emissions Inventory
AFI	Air Force Instruction
AICUZ	Air Installation Compatible Use Zone
AOC	Area of Concern
APZ	Accident Potential Zone
bgs	Below Ground Surface
Bld.	Building
BMP	Best Management Practice
BX	Base Exchange
CATM	Combat Arms Training Range
CFR	Code of Federal Regulations
CIP	Capital Improvement Projects
CO	Carbon Monoxide
CY	Calendar Year
dB	Decibel(s)
DoD	Department of Defense
EIAP	Environmental Impact Analysis Process
EO	Executive Order
EOD	Explosive Ordnance
ER	Environmental Review
ESQD	Explosive Safety Quantity Distance
FGS	Final Governing Standards
ft	Foot/Feet
ft <sup>2</sup>	Square Feet
FY	Fiscal Year
gal	Gallon
GIS	Geographic Information System
HWMP	Hazardous Waste Management Program
HWPM	Hazardous Waste Program Manager
HWSA	Hazardous Waste Storage Area
ICRMP	Integrated Cultural Resources Management Plan
JEGS	Japan Environmental Governing Standards
KAB	Kadena Air Base
km	Kilometer(s)
km <sup>2</sup>	Square Kilometer(s)
lbs	Pound(s)
m	Meter(s)
MEB	Marine Expeditionary Brigade
mi <sup>2</sup>	Square Mile(s)
MILCON	Military Construction
N/A	Not Applicable
NEPA	National Environmental Policy Act
NO <sub>x</sub>	Nitrogen Oxides
NRMU	Natural Resources Management Unit
ODS	Ozone Depleting Substance
OHS	Oil and Hazardous Substance
OPG	Okinawa Prefectural Government
OPRDB	Okinawa Prefecture Red Data Book
PM <sub>10</sub>	Particulate Matter with a Diameter Less than or Equal to 10 Microns

## **LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS CONT'D**

<b>ppm</b>	Parts per Million
<b>RDB</b>	Red Data Book (Japanese)
<b>ROI</b>	Region of Influence
<b>SO<sub>2</sub></b>	Sulfur Dioxide
<b>SOFA</b>	Status of Forces Agreement
<b>SO<sub>x</sub></b>	Sulfur Oxides
<b>SPCC</b>	Spill Prevention Control and Countermeasures
<b>SPRP</b>	Spill Prevention and Response Plan
<b>SWPPP</b>	Stormwater Pollution Prevention Plan
<b>U.S.</b>	United States
<b>USACE</b>	U.S. Army Corps of Engineers
<b>USPACAF</b>	U.S. Air Forces, Pacific Command
<b>USPACOM</b>	U.S. Pacific Command
<b>UXO</b>	Unexploded Ordnance
<b>VOC</b>	Volatile Organic Compound

## **1. PURPOSE FOR THE ACTION**

### **1.1 PROPOSED ACTION**

Army and Air Force Exchange Service (AAFES) proposes to construct a new Base Exchange (BX) at Kadena Air Base (KAB) in Okinawa Japan. The new BX would provide a 330,438-square-foot, two-story shopping complex. The facility is designed to provide a one-stop shopping experience for base personnel, their families, and retired military in the region. The new BX would contain the main store, two food courts, and a concession mall along with other amenities.

The action would require that the AAFES construct new facilities and demolish two existing buildings on the main base. Associated with this action would be parking lot construction and associated infrastructure such as utility hook-ups to the new buildings. The new facility would not increase the number of military personnel at Kadena Air Base, as it is a replacement for an already existing facility. The facility would begin construction in Fiscal Year (FY) 2008. The regional setting of this Proposed Action is shown in Figure 1-1.

### **1.2 PURPOSE AND NEED OF THE PROPOSED ACTION**

The purpose of the BX construction is to provide a more updated and expanded shopping experience on base for current and retired personnel living on and around KAB. The Kadena main store is fragmented and is of insufficient size to meet current base needs for both sales and storage. Additionally, AAFES considers the current facilities for parking and food concessions as inadequate.

### **1.3 ENVIRONMENTAL REVIEW FRAMEWORK**

This environmental review is conducted in accordance with the following:

- Department of Defense (DoD) *Japan Environmental Governing Standards*. Headquarters, U.S. Forces, Japan. August 2004.
- Executive Order (EO) 12114. Environmental Effects Abroad of Major Federal Actions.
- DoD Directive 6057.2 and 32 Code of Federal Regulations (CFR) Part 187. Environmental Effects Abroad of Major Department of Defense Actions.
- 32 CFR 989. Environmental Impact Analysis Process (EIAP).

The Japan Environmental Governing Standards (JEGS) provide specific policies, procedures, and environmental compliance criteria for ensuring that DoD activities and installations in the host nation protect human health and the natural environment. The DoD consolidated the JEGS working with all service components and installations within the host nation, the American embassy and the host nation governmental agencies. The JEGS are the Final Governing Standards (FGS) created for the host nation based on United States (U.S.) overseas requirements, Japanese environmental laws, base rights and the Status of Forces Agreement (SOFA) and other

international agreements. The JEGS is the sole source document of environmental compliance and requirements, and the primary source document of environmental guidance and standards for service components in Japan.

EO 12114 directs federal agencies to consider environmental impacts in making decisions regarding actions of the federal government. DoD Directive 6057.2, which is codified in 32 CFR Part 187, provides policies, definitions, and procedures to implement EO 12114 for the DoD agencies. This directive requires environmental impact analysis for certain major federal actions that have significant effects on the environment outside of the geographical borders of the United States, its territories, and possessions. DoD Directive 6057.2 limits the requirement to conduct environmental impact analysis to only those major federal actions that affect the global commons, ecological resources of global importance, or the environment of a foreign nation, or that provide a toxic or radioactive emission or effluent to a foreign nation. An Environmental Review (ER), as described under Enclosure 2 of DoD Directive 6057.2, is a survey of the important environmental issues involved in a proposed major federal action. It does not include all possible environmental issues and it does not include the detailed evaluation required in an environmental impact statement. The review must include a description of the Proposed Action, an identification of the important environmental issues, aspects of the Proposed Action that ameliorate or minimize the impact on the environment, and any actions taken or planned by a participating foreign government that will affect environmental considerations.

The Air Force's EIAP (32 CFR 989) provides procedures for environmental impact analysis both within the United States and abroad. Parts 37 and 38 of 32 CFR 989 address the procedures and requirements for analysis abroad, and refer to 32 CFR 989, Part 187, *Environmental Effects Abroad of Major Department of Defense Actions*, for implementation.

AAFES will circulate the ER for review and comment by the U.S. Air Forces, Pacific Command (USPACAF) host installation. Based on the results of the impact analysis, the USPACAF host installation commander will issue a Determination of Impacts.

## 1.4 SCOPE OF THE ENVIRONMENTAL REVIEW

AAFES prepared this document in accordance with the regulations outlined for DoD installations overseas (Section 1.3) and the JEGS developed for the host nation. Due to the Proposed Action being located overseas and the sole source of requirements being the JEGS, the U.S. National Environmental Protection Agency (NEPA) requirements are not applied. Therefore in this ER, a "NEPA-like" impact analysis and review of issues is applied using the JEGS developed for the host nation, with consideration of other environmental issues that are pertinent to the Region of Influence (ROI). Therefore, this section identifies those issues that are eliminated from this review and those issues that will be carried forward in the review.



Figure 1-1. Regional Setting of the Proposed Action



#### **1.4.1 Environmental Issues Eliminated Through Preliminary Impact Analyses of the Proposed Action and Alternatives**

Preliminary impact analysis has eliminated airspace, utilities, land use, floodplains, wetlands, socioeconomic issues, noise, transportation, and safety as issues for detailed analysis.

Impacts to airspace have been eliminated as an issue. The Proposed Action would not affect current use of airspace.

Floodplain, groundwater and wetland impacts have been eliminated as issues. The Proposed Action does not impact groundwater sources or occur within or adjacent to an existing floodplain or wetland.

Socioeconomic factors are not an issue with this project. Local residents would be involved in the construction of facilities, roads, and utilities. There would be no appreciable increase in permanent personnel to affect the local economy. More employment opportunities may be possible on Kadena AB owing to the operation of the new facility. It is assumed that currently available local personnel would fill any new positions above those offered by the current BX operation.

Noise is not an issue with the Proposed Action. The project is not located within any recognized high noise (65 decibels [dB] or above) zones. Ground clearing, grading, and construction would produce noise from heavy machinery but these effects would be noticed primarily during daylight hours and would be temporary.

Impacts to traffic and utilities have been eliminated as an issue. Kadena AB personnel are confident that the present infrastructure of the base will support the BX facility with no added major infrastructure improvements save for surface parking and new access points into the facility. The proposed action will not result in the closure of a major public (i.e., non-military) thoroughfare or increase traffic in measurable volume such as the capacity ratio of local roads (Stocker, 2007).

Impacts to safety have also been eliminated as an issue. The project is not located near any Accident Potential Zones (APZs). APZs are geographic areas around the airfield where historical data have shown where most aircraft accidents occur. In addition, the project area is not located near any explosive safety quantity-distance (ESQD) clearance zones that provide safe setback areas around explosive-handling facilities. Standard and accepted safety practices will be used by AAFES during the construction and demolition of facilities.

Land use on KAB is generally compatible with mission requirements with few conflicts. The Proposed Action was screened for potential overlap of proposed BX use with existing land use types. The building construction and facility use components of the Proposed Action occurring on main base would be compatible with actions occurring there now. Components of the Proposed Action associated with the operation sites occur within areas designated for community commerce and open usage. The physical locations of the operation site are therefore compatible with existing land use.

Impacts resulting from hazardous materials have been eliminated from detailed analysis. The Proposed Action would not significantly increase hazardous wastes flow or hazardous materials. As the proper handling, use, and disposal of hazardous materials and waste are routine at KAB, personnel will adhere to the present JEGS tracking and reporting requirements as well as the KAB spill prevention and response plan (SPRP) developed in February 2003 and most recently reviewed in July 2005. All generated solid waste will be transported off base through a permitted contractor for disposal in an off-base landfill. Solid waste associated with demolition and construction activities would be recycled and thus have little or no impact. Solid waste management would be implemented within the JEGS requirements and the SPRP being executed at KAB. Management requirements for the proper handling of these wastes during construction are presented in Chapter 6.

### **1.4.2 Issues Associated with the Proposed Action**

Potential impacts resulting from the Proposed Action are associated with the following resource categories:

#### **Air Quality**

Construction has the potential to generate combusive emissions and dust, temporarily reducing air quality on and off base. In addition, the potential usage of on-site generators and boilers is also examined.

#### **Water Resources**

Construction of facilities and parking lots would increase impervious surface area. This has the potential to increase the amount of stormwater and associated pollutants potentially transported into nearby surface waters.

Construction or modification of stormwater box culverts and engineered stream banks will also need to be discussed as they relate to maintaining water quality and handling stormwater.

#### **Soil Resources**

Ground clearing and grading from construction would potentially increase wind and waterborne soil erosion. The proposed location is adjacent to a steeply banked creek that would increase the risk of erosion. Erosion of reddish soil into water bodies is currently an issue for some areas of Okinawa.

#### **Cultural Resources**

Ground clearing, grading activities, and building construction would potentially affect cultural resources.

#### **Biological Resources**

The Proposed Action would potentially require tree and shrub removal, which may harm protected species or their habitat.

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## 2. PROPOSED ACTION DESCRIPTION

### 2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

AAFES proposes to construct a new BX on Kadena AB (Figure 2-1). This new facility would replace the existing BX located directly northeast of the proposed construction (Figure 2-2). To support the mission of current and future personnel on Kadena AB, AAFES would provide and operate upgraded and enlarged BX facilities, expanded parking, limited infrastructure improvements, and would demolish the currently existing outmoded facility. For the purposes of analysis, elements of the Proposed Action include facility construction and subsequent operation, and existing facility demolition.

A mitigation plan can be found in Appendix B of this document. AAFES will comply with recommended mitigations concerning the Proposed Action to avoid potential harm to identified significant resources.

#### 2.1.1 Construction and Repair

Figure 2-1 depicts the locations of assets (e.g., buildings, parking, fencing) AAFES needs to construct or demolish. Table 2-1 lists each asset, proposed function, square footage, and the action to be undertaken in reference to these structures. In summary, AAFES would construct a new BX totaling 330,438 square feet (ft<sup>2</sup>), and subsequently demolish 154,014 ft<sup>2</sup> of existing structures that would then be replaced by additional surface parking. The land proposed for this action is primarily cleared, covered with grass and small shrubs and trees, paved, or currently developed. Following the construction of the new BX, the existing BX would be demolished and the underlying property would be paved and used for surface parking.

**Table 2-1. Summary of Asset Construction and Demolition**

Proposed Function	Asset	Action	Area (ft <sup>2</sup> )
Current BX	Bld. 413	Demolish	126,616
	Bld. 409	Demolish	27,398
Proposed BX	New Bld. on cleared land SW of current BX Facility	Construct	330,438
Parking	where Bld.413 currently sits	Construct	N/A

Bld. = building; N/A = not applicable; SW = Southwest

### 2.2 NO ACTION ALTERNATIVE

The No Action Alternative would be for AAFES not to construct the proposed BX on Kadena AB. Personnel at Kadena AB would continue to use existing BX facilities and would not benefit from newer and more expansive AAFES services.

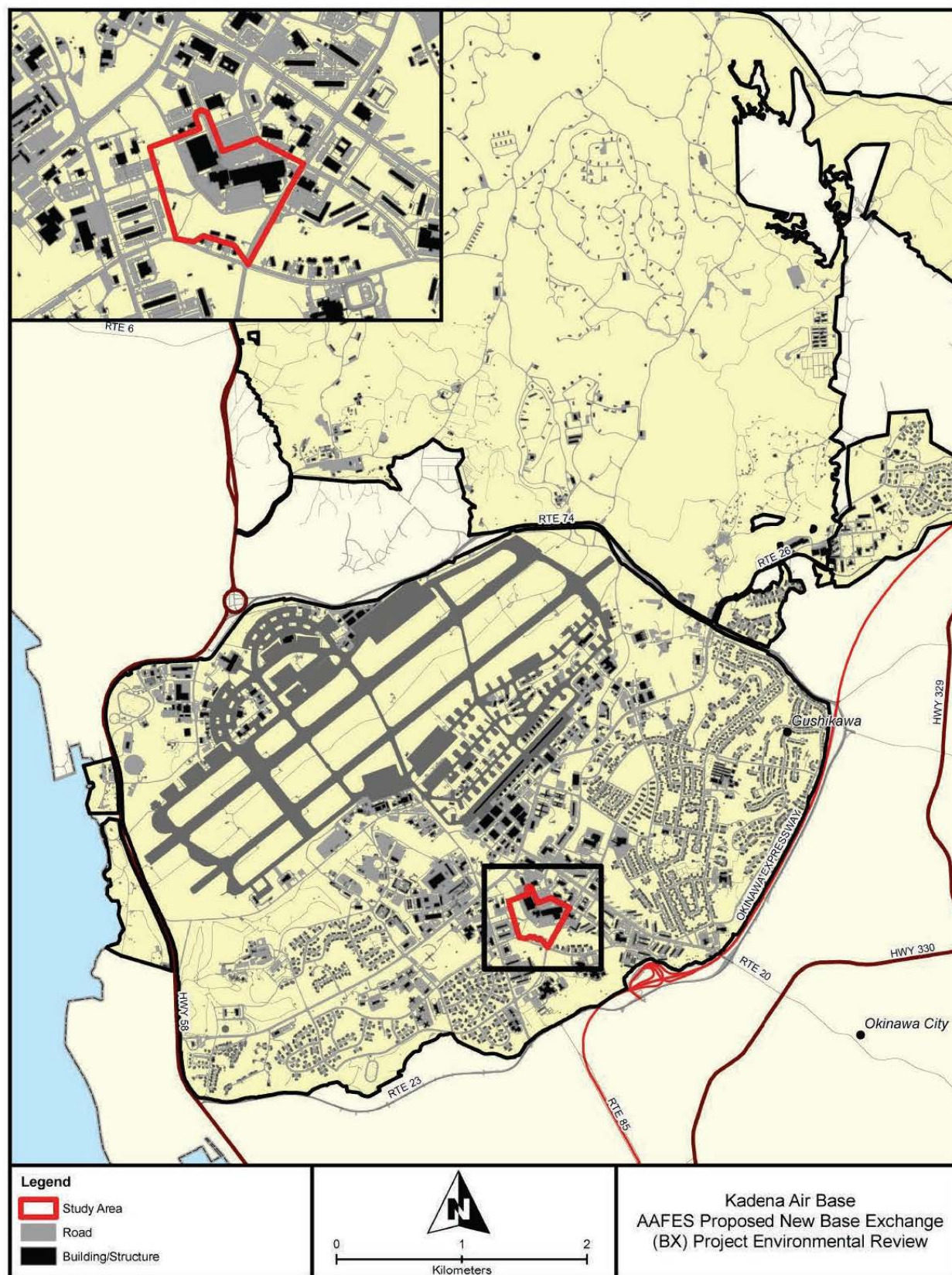


Figure 2-1. Proposed BX Building Location



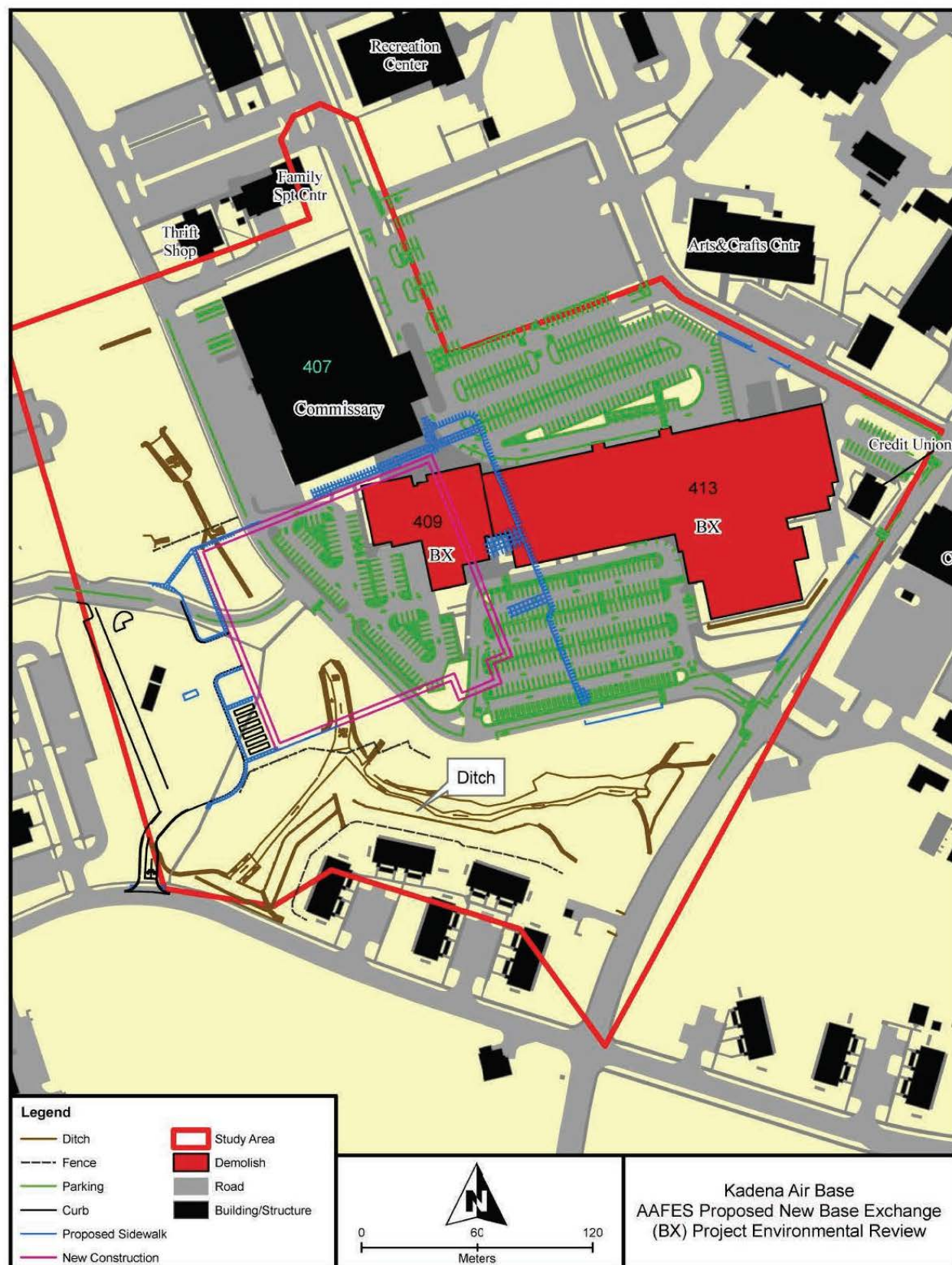


Figure 2-2. Site Construction Plan

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### 3. AFFECTED ENVIRONMENT

#### 3.1 AIR QUALITY

Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. The levels of pollutants are generally expressed on a concentration basis in units of part per million (ppm) or micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Although there is an air monitoring network similar to the site-specific volumetric analyzers used in the United States to determine compliance with the U.S. National Ambient Air Quality Standards, data results from the Japanese air monitoring network were not available for the specific prefectures where the proposed activities would occur. In situations where air monitoring data is unavailable, emissions inventory data is used as a baseline and compared to the emissions associated with the proposed activity.

Despite the fact that air monitoring network data and stationary source emissions inventory data were not available for KAB, mobile source emissions data for Calendar Year (CY) 2004 was available and Table 3-1 provides a summary.

**Table 3-1. Criteria Pollutant Emissions from Mobile and Stationary Sources**

Emissions* Type	NO <sub>x</sub>	CO	VOC	PM <sub>10</sub>	SO <sub>x</sub>
Mobile**	411.78	1,064.96	197.17	172.75	60.62
Stationary***	57.46	28.53	150.41	17.98	33.50
<b>Totals</b>	<b>469.24</b>	<b>1,093.49</b>	<b>347.58</b>	<b>190.73</b>	<b>94.12</b>

NO<sub>x</sub> = Nitrogen Oxides; CO = Carbon Monoxide; VOC = Volatile Organic Compounds;

SO<sub>x</sub> = Sulfur Oxides

\*Emissions are represented in tons per year

\*\* Mobile emissions data as represented in 2002 Air Emissions Inventory (AEI)

\*\*\* Stationary emissions data as represented in 2004 AEI

##### 3.1.1 Air Quality Standards

Air quality standards are governed under the JEGS. The JEGS provide specific equipment standards and reporting requirements for the following equipment: steam and hot water generating units, incinerators, chromium electroplating and chromium anodizing tanks, halogenated solvent cleaning machines, units containing ozone-depleting substances (ODS), and motor vehicles. Additionally, the JEGS address open burning (U.S. Forces, Japan, 2006). Appendix A contains detailed requirements for specific types of equipment identified in the JEGS.

#### 3.2 WATER RESOURCES

This section provides information on surface waters, ground water, wetlands, and stormwater drainage patterns within the project area.



### 3.2.1 Surface Waters

There are no natural lakes or rivers on KAB, though several natural streams are present and receive water from the base stormwater system (U.S. Air Force, 2004a). An intermittent stream is adjacent to the proposed construction site, and a small perennial river lies approximately 110 meters (m) to the south. There are no other natural surface water bodies near the proposed construction site (Figure 3-1).

### 3.2.2 Stormwater

As mandated in the JEGS, KAB manages stormwater runoff within the guidelines of a Stormwater Pollution Prevention Plan (SWPPP). Stormwater discharge from KAB is diverted into the installation's stormwater conveyance systems and natural ravines (Figure 3-1). The natural streams on KAB are utilized as part of the network of stormwater discharge. All stormwater generated on KAB either discharge at the East China Sea or into the Hija River which also drains into the East China Sea. The Hija River also serves as one of the water sources for the Chatan WTP (Kuniyoshi, 2007). The western half of the main base airfield drains into the East China Sea through a series of drainage ditches. The eastern half of the airfield collects in drainage ditches that discharge into the Hija River (U.S. Air Force, 2004a).

Soil erosion due to stormwater runoff is an issue of concern on Kadena AFB. Soils in the area are very prone to erosion. Under normal rainfall conditions on undisturbed lands, the vegetative cover and its associated root layer protects the soil from direct rainfall impact and helps hold the soil in place. During heavy precipitation events (e.g., typhoons), the unconsolidated soils become saturated with water and entire hillsides can slump or slide downhill. The soil with its water load becomes so heavy that a plastic flow develops along the interface where the saturated zone meets either a drier, unsaturated soil or bedrock. Under these circumstances, even a dense vegetation cover will not protect the soil, and the vegetation will slide with the soil (U.S. Air Force, 2004). When dealing with areas that have been cleared of their natural vegetation, these conditions are amplified.

Activities associated with construction, such as using heavy equipment on wet soil and vegetation removal increase erosion and facilitate in sediment transport to base stormwater infrastructure systems. Low-lying areas on base tend to flood due to sediment-clogged storm sewers, collection boxes, and drainage ditches (U.S. Air Force, 2004).

### 3.2.3 Water Quality

Surface water and groundwater quality within the project area is expected to be good based on sample results and implementation of protective measures. The 18<sup>th</sup> Civil Engineer Squadron, Bioenvironmental Engineering Flight (18 AMDS/SGPG), and the OPG, monitor streams, stormwater outfalls, and shoreline locations for water quality within and outside KAB. Monitoring results have not indicated the presence of pollutants or water quality parameters that exceed benchmark concentrations (Kuniyoshi, 2007).



Figure 3-1. Stormwater System Within the Project Area

The 718<sup>th</sup> Civil Engineer Squadron, Environmental Flight (718 CES/CEV) administers the SPRP, the SWPPP and best management practices (BMPs) for erosion control to protect surface and ground water quality. The SPRP incorporates a Spill Prevention Control and Countermeasures (SPCC) Plan and the Oil and Hazardous Substance (OHS) Pollution Contingency Plan. The 18 AMDS/SGPG regularly monitors groundwater sampled from base wells (U.S. Army, 2005). The 718 CES/CEV reviews each construction project specification document on KAB for erosion control requirements to protect water quality. The BMPs to prevent pollutant loading into receiving water bodies during construction activities include the use of sediment barriers, grading controls, and measures to prevent vehicle tracking of sediment. The 718 CES/CEV can inspect construction sites for implementation of erosion control BMPs, however, this is not a routine requirement for construction projects.

### 3.3 SOILS AND GEOLOGY

This section discusses soil types within the proposed project area described in Chapter 2. Depending on their properties and the topography in which they occur, soils have varying degrees of susceptibility to erosion. This section will discuss the potential that soils underlying the KAB proposed project site have for erosion. This section will also consider regional geology and potential hazards resulting from regional geology.

The Ryukyu Islands are the emergent parts of a geotectonic arc that extends from the island of Kyushu, Japan to the northeast coast of Taiwan (U.S. Air Force, 2004). The location of Okinawa along the Philippine/Eurasian plate subduction zone makes this one of the most geologically active regions in the world. Always present environmental hazards around KAB include typhoons, earthquakes, and volcanic eruptions. The area averages one magnitude 5 or greater earthquake every year (USGS, 2006). An additional hazard to the area is that regional seismic activity under specific circumstances may generate tidal wave activity.

Southern Okinawa is located within a formation known as the Shimajiri Belt. Layers of upper Tertiary clay, silt, sand, gravel, and limestone characterize this feature. The bedrock beneath KAB is a coral limestone formation that occurs as surface outcrops in areas within the base and also ranges in depth from 20 to 30 ft below the surface (U.S. Air Force, 2004).

The physiographic makeup of KAB consists of a limestone-bedded terrain consistent with other areas of the southern provinces. The southern portion of the island is characterized by low-lying rolling terrain with coastal plains ascending to dissected uplands in the interior (U.S. Air Force, 2004). Like the soil characteristics described below, topography and surface drainage features, specifically, are potential erosion factors to consider when undertaking construction-related activities.

Soil orders within KAB are listed as Alfisols, and Ultisols (U.S. Air Force, 2004). Alfisols at KAB are formed from moderately weathered materials of subtropical regions. These soils have high clay content with erosive episodes during high rainfall. At KAB, the representative alfisol is Shimajiri Mahji soils. This is a neutral, limestone-based soil (Rhodualts) that is typically silty

to silty clay with coral limestone bedrock as the bedrock material (U.S. Air Force, 2004). Ultisols occur in areas that experience high precipitation over geologically mature landscapes. Specifically, ultisols at KAB consist of Kumigami Mahji soils that are diluvial unconsolidated sediments (Hapudults). These soils are typically red-yellow, acidic soils with little organic content. Because of the small amount of organic content present in the soil, trees are considered necessary for biocycling nutrients through the soil. When deforestation occurs in these soil zones, soil fertility often rapidly degrades (U.S. Air Force, 2004).

In general, the soils within the project area are moderately susceptible to water erosion under natural conditions, though nearly all silty soils have a high susceptibility to erosion if exposed. The proposed site was previously developed and landscaped and would potentially require additional grading as part of any new construction activity.

### 3.4 CULTURAL RESOURCES

Regulations that govern U.S. Air Force activities overseas and that relate to potential impacts on cultural resources include the host nation's Environmental Governing Standards (U.S. Forces, Japan, 2004); they provide specific policies and environmental compliance criteria for ensuring that DoD activities and installations do not damage the host nation's environment. EO 12114, "Environmental Effects Abroad of Major Federal Actions," in conjunction with Air Force Instruction (AFI) 32-7006, "Environmental Program In Foreign Countries," and AFI 32-7061, "Environmental Impact Analysis Process," set guidelines within which federal agencies abroad must work, and stipulate coordination with host nations to consider and study potential environmental impacts resulting from those agencies' actions. These standards will be used to determine if there is significant harm to cultural resources due to the Proposed Action. Cultural Resource site review prior to construction and repair work is covered under Section 12-3.8a of the JEGS and Sections 4.1.2 and 4.1.3 of the Base Integrated Cultural Resources Management Plan (ICRMP) (U.S. Air Force, 2004c).

A wide variety of cultural resources spanning at least 30,000 years is known to be present on Okinawa (U.S. Air Force, 2004c). On KAB there are identified sites from the Shellmound Era (8,000 B.C. to 1,000 A.D.) to the modern historic period. There is also a possibility of earlier Late Paleolithic sites (30,000 B.C. to 8,000 B.C.) being present on KAB due to their presence on other parts of the island (Pearson, 1969).

Kadena AB has completed a Cultural Assets Survey (Haun, 1993) that includes large-scale maps depicting the locations of known cultural resource sites. The Cultural Assets Survey, geographical information system (GIS) layers and the ICRMP (U.S. Air Force, 2004c) were reviewed in detail to determine whether any sensitive cultural resources are known to be present in the vicinity of the project sites. Graphics depicting the location of cultural resource sites identified during this review or during field surveys are not provided in this report because of AFI 32-7065, which seeks to protect the resources from potential vandalism.

Almost 900 structures on KAB are 50 years old or older with an additional 1000 or more structures considered to be Cold War period structures (1946–1989). Under Air Force guidelines

and JEGS, any structures 50 years old or older or associated with significant periods or events (e.g., the Cold War) must be considered as potential historic structures and afforded consideration. There are two known historic structures in the footprint of the proposed facility, buildings 409 and 413 (Table 3-2).

**Table 3-2. Identified Structures Within Project Area**

Building #	Building Description	Status	Built
409	AAFES Exchange Sales Store	Demolition	1953
413	AAFES Exchange Sales Store	Demolition	1955

Both of these pillar and block concrete structures have been evaluated and have been determined to be not historically significant. Both structures have been extensively modified in the 1950s, 1960s, and 1970s (Komine, 2007).

Five archaeological resources (O-04-10-022, O-24-10-007, Site 277, tombs within project area, and O-04-10-020) are within a quarter-mile radius of the proposed project area. Of these, three sites are known tombs or tomb complexes; one site contains functional components to previous village locations; two provide evidence of shrine usage; and one is a historic bridge. Figure 3-2 shows previously identified archaeological sites outside of the project area within ¼ mile and Table 3-3 lists these resources with a brief description and condition assessment of each.

**Table 3-3. Known Archaeological Sites Within One-Quarter Mile of the Project Area**

Site Number	Name	Site Description	Condition
O-24-10-007	Meenukaa	Tomb complex, well	Good
O-04-10-022	Bijuru No Hi	Tomb complex, shrine?	Good
O-04-10-020	Unknown	Natural Prayer Site	Not stated
277	Ukumagai Bridge	Bridge	Good
N/A	Tomb Complex Adjacent to Project Area (currently being analyzed)	Tomb complex	Good

Source: adapted from U.S. Air Force, 2004c

***Cultural Resource Sites O-24-10-007 and O-04-10-022, Meenukaa and Bijuru No Hi Tomb Complexes and Tomb Complex within Project Area***

Okinawan tombs are considered the most numerous and visually obvious of all cultural resources located at KAB. These tomb complexes are but two groups among the 64 tomb sites documented throughout Kadena AB. These sites have been documented to contain from 1 to 138 individual interments (U.S. Air Force, 2004c). Traditional host nation tomb sites are familial based in origin and are used for the purposes of ancestor remembrance and family ceremonies. Three different types of tombs are present at KAB, known as *aji-baka*, *fuso*, and *hafu* or *kamekobaka*. These are lineage founder tombs, cave-based tombs, and masonry tombs with walled courtyards, respectively. Locations overlooking running water and away from arable land seem to be preferred tomb locations, as is the case with the tombs within the project area, O-24-10-007 and O-04-10-022. Additional details on the *kamekobaka* tomb complex within the project area will be provided when the survey of this resource has been completed.



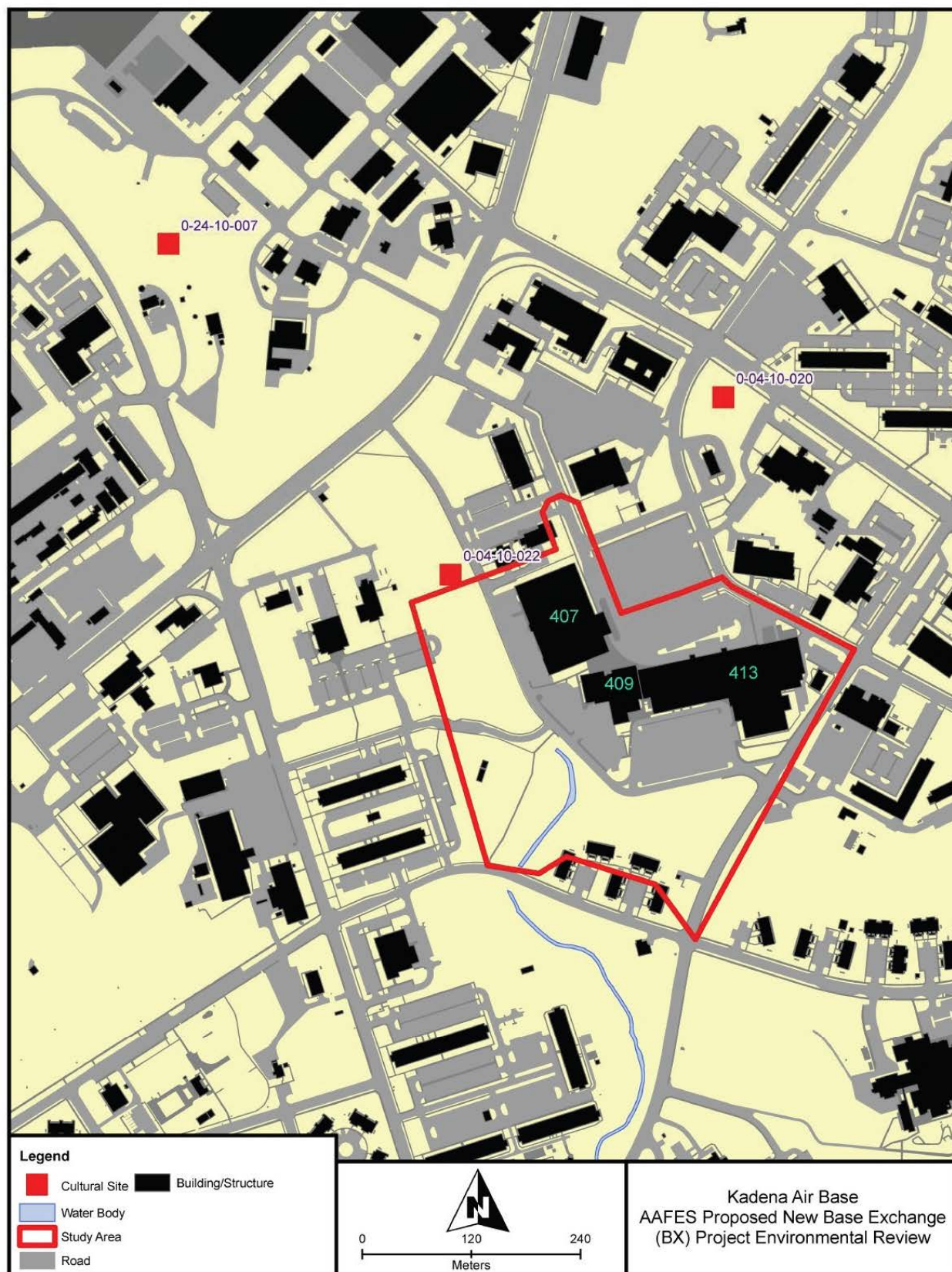


Figure 3-2. Previously Identified Archaeological Sites Within One-quarter Mile of Project Area

***Cultural Resource Site 277, Ukumagai Bridge***

Ukumagai Bridge is a concrete bridge constructed in 1930. Previously in this location, a stone bridge was constructed in 1923 that had replaced a previously existing wooden bridge. This bridge is about 20 feet from the Libaru Gumi Bijuru shrine.

***Cultural Resource Site O-24-10-007, Meenukaa Well***

Features such as wells, architectural elements and pathways may identify former village sites on KAB (U.S. Air Force, 2004c). There is a well associated with an adjacent tomb complex.

***Cultural Resource Sites O-04-10-020, no number assigned, and O-04-10-022, Unknown Natural Prayer Site, Libaru Gumi Bijuru and Bijuru No Hi Shrines***

These three shrines are among the 19 identified shrine sites located throughout Kadena AB. Shrines may consist of any place of ritual worship, although generally these sites are dedicated either to public communal rituals (*kami ashagi*), sacred tree groves (*utaki*), or sites honoring the village founder (*niiyaa*) (U.S. Air Force, 2004c). Many of these sites can be found in secluded locations or on hilltops, while some mark the former location of a specific village.

**3.5 BIOLOGICAL RESOURCES**

This section provides a description of the vegetation and wildlife within the project area. The potential occurrences of endangered, threatened or otherwise protected species are identified for this location. Additional information and species locations are provided in a separate document entitled *Natural Resource Survey of the Kadena Base Exchange Expansion Project Area*, developed to examine the Proposed Action (Minton, 2007).

**3.5.1 Vegetation**

Much of the native vegetation on Okinawa was eradicated during World War II. Today KAB is largely developed with grassy areas; ornamental landscaping and some isolated forested areas. Forty varieties of ornamental shrubs, trees, and grasses planted for base landscaping were inventoried in the 1970s and 1980s (Figure 3-3; U.S. Air Force, 2004). In addition to being a natural resource, certain species have cultural resource significance. Native residents place cultural significance on the Taiwan cherry (*Prunus campanulata*), diego (*Erythrina orientalis*), and banyan tree (*Ficus microcarpa* and *Ficus retusa*) (U.S. Air Force, 2003). Special consideration should be given to preserve species such as diego, due to its recognized status as a prefecture flower.



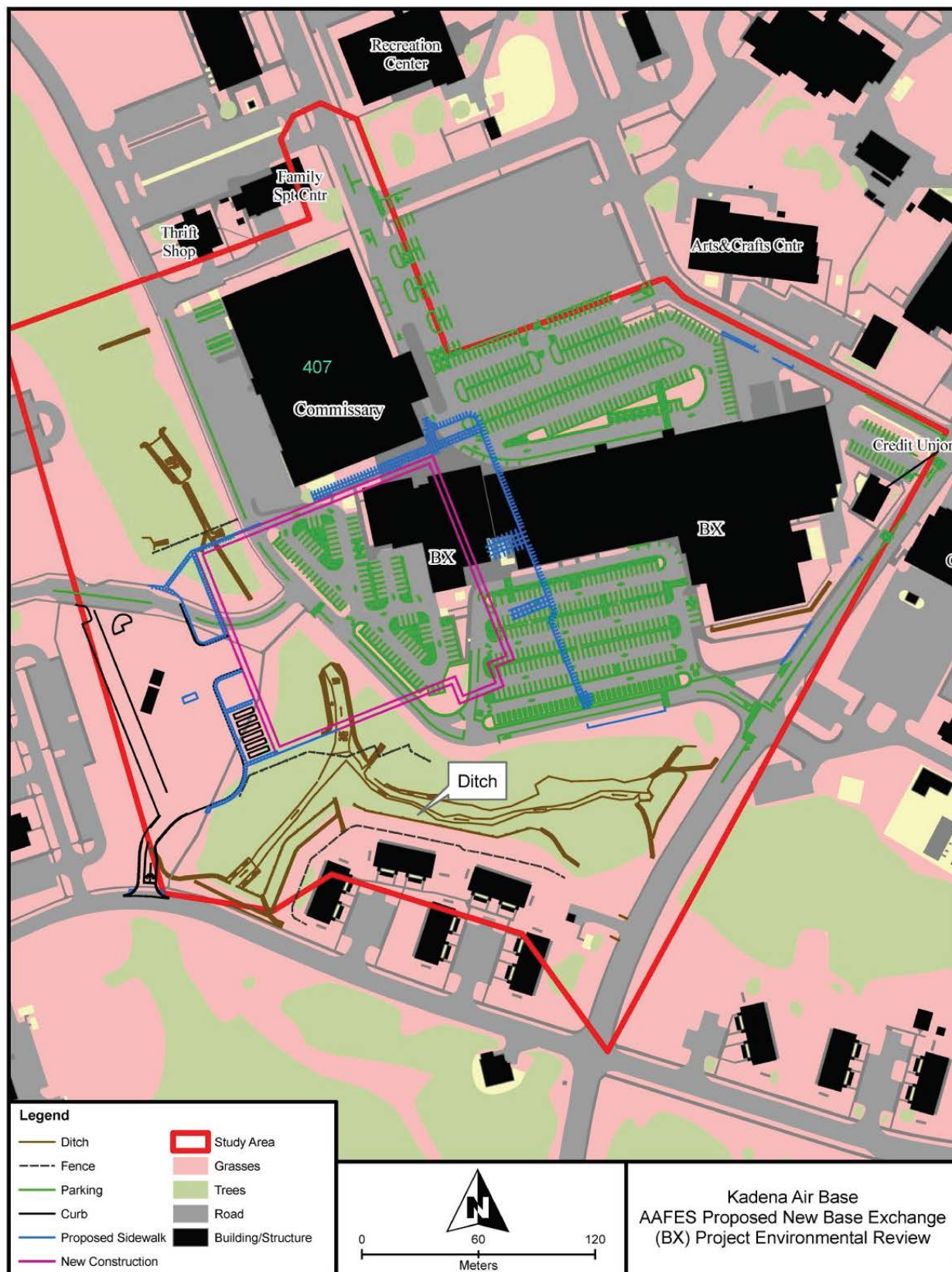


Figure 3-3. Plant Communities Within the Proposed Project Area



### 3.5.2 Wildlife

With the exception of birds, wildlife is unlikely to occur within the Proposed Action construction location on main base. There are isolated natural habitats at other areas within the main base expected to support wildlife. A survey of the human-managed areas and natural habitats of the main base cantonment areas recorded 51 bird species (U.S. Air Force, 2004).

Several other types of wildlife species occur in natural habitats found on the main base, including within or adjacent to proposed operations sites. In addition to birds, small mammals, reptiles and amphibians are documented to occur on the main base in forested ravines, which are characterized by streams, caves and lush vegetation. The ravines, which the Air Force declared off-limits, have been relatively undisturbed for almost 50 years. These areas provide a variety of moist vegetated habitats and climates for numerous species.

Results of a 1998 survey of the main base reported in the INRMP listed 18 species of birds, two mammal species, six reptile and three amphibian species (U.S. Air Force, 2004). Additionally, four species of fish, two species of snails, two genera (the classification level above species level) of spiders and 47 insect species were listed in the 1998 report. Two of the reptile species [the Okinawa tree lizard (*Japalura polygonata*) and the green grass lizard (*Takydromus smaragdinus*)], native to Okinawa are declining (U.S. Air Force, 2004). One of the mammals, Orii's flying fox (*Pteropus dasymallus inopinatus*) is a protected species of bat and the Java mongoose, is an invasive species that has adversely harmed native species and ecosystems (U.S. Air Force, 2004).

### 3.5.3 Protected Species

This section identifies protected species or their habitat that may occur within proposed project areas. To document the presence of threatened or endangered plants and animals, the project areas was surveyed for protected species prior to any ground clearing activity.

Protected species are those plants or animals considered to be at risk of extinction, and that are protected by U.S. law, Japan law, or a treaty signed by the United States (U.S. Forces, Japan, 2004). The JEGS state, "installations shall take reasonable steps to protect and enhance known endangered or threatened species and host nation protected species and their habitat" (U.S. Forces, Japan, 2004). Additionally, the Japanese government lists protected species in the Japan RDB and the Okinawa Prefecture Red Data Book (OPRDB). The RDB is published by the World Conservation Union, formerly the International Union for the Conservation of Nature and Natural Resources (ICUN, 2006). The Japan RDB lists 693 animal species and 102 plant species, while the OPRDB lists 313 animal species and 644 species of plants (U.S. Air Force, 2004). Several species listed in the RDB and OPRDB have been documented to occur on the main base. Appendix B lists RDB animal species that occur on Okinawa.

The installation is currently completing a biodiversity survey and inventory by habitat type for all areas of the main base. The survey will list protected species by habitat type, as required in the JEGS (U.S. Air Force, 2004). Surveys have been conducted in the Natural Resource

Management Units (NRMUs) on the main base and have documented the occurrence of several species that are listed as protected species in the RDB or the OPRDB.

The recent Natural Resources Survey completed in support of this ER (Minton, 2007) made relatively few wildlife observations within the project area. *Bishofia javanica* was noted in six locations in and around the project area. One special status bird, the gray-faced buzzard eagle (*Butastur indicus*) and one special status arachnid, a colony of the Okinawan Kimura's trap door spiders (*Ryuthela nishihirai*) were also noted in the general area. Both of these species have a "vulnerable" status; however, the gray-faced buzzard eagle is a winter migratory species not annually present within this area, and the Okinawan Kimura's trap door spiders were documented outside of the project area (Minton, 2007).

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## 4. ENVIRONMENTAL CONSEQUENCES

### 4.1 AIR QUALITY

Section 3-1 provides background information regarding the current emissions levels at KAB based on data provided for stationary and mobile sources. This section discusses the potential harm to air quality because of the Proposed Action, Alternative Action, and No Action Alternative. For the analysis of the various Proposed Actions, thresholds on a pollutant-by-pollutant basis were established.

#### 4.1.1 Significance Criteria

In order to evaluate the air emissions and their impact to the area of concern (AOC), the emissions associated with the project activities were compared to the total base emissions on a pollutant-by-pollutant basis, as reflected in the Stationary and Mobile Source Emissions Inventories. Potential impacts to air quality are identified as the total emissions of any pollutant that equals 100 percent or more of the base's emissions for that specific pollutant. The 100 percent criterion approach is used as an indicator for impact analysis.

A DoD-developed model, the Air Conformity Applicability Model (ACAM), the U.S. Air Force uses for conformity evaluations, was utilized to provide a level of consistency with respect to emissions factors and calculations. Air emissions estimated using ACAM are compared to the established 100 percent criterion for KAB as represented in the KAB Stationary and Mobile Source Emissions Inventories. Emissions associated with combustion and construction activities are the main issues the Proposed Action generates and were the focus of the air analysis.

#### 4.1.2 Overview of Impacts

Based on the established significance criteria, an air quality analysis was performed for the alternatives and No Action Alternative. None of the alternatives will harm air quality significantly based on the criterion established for this ER.

#### 4.1.3 Proposed Action

Based on the air quality analysis and significance criteria established, the Proposed Action would not influence air quality significantly based on the criterion established for this ER. Table 4-1 below illustrates the emissions associated with the Proposed Action in comparison to the established baseline.

**Table 4-1. KAB Emissions in Comparison to Proposed Activities**

Emissions Type	NO <sub>x</sub>	CO	VOC	PM <sub>10</sub>	SO <sub>x</sub>
Mobile	411.78	1,064.96	197.17	172.75	60.62
Stationary	57.46	28.53	150.41	17.98	33.50
Proposed Action	25.54	63.10	4.68	24.05	1.29
Percentage of Proposed Action to Base Totals	5%	6%	1%	13%	1%

\*Emissions are expressed in tons per year

#### 4.1.4 No Action Alternative

The No Action Alternative will not increase emissions and therefore will not influence air quality significantly based on the criterion established for this ER.

## 4.2 WATER RESOURCES

Water resources include surface waters, wetlands, and groundwater. Harm can result from direct physical alteration, or indirectly from sediment runoff or introduction of contaminants.

### 4.2.1 Significance Criteria

The Proposed Action would have significant harm if project construction directly altered water flow or water levels in surface waters or wetlands or reduced water quality in these systems and groundwater. Sediment from construction sites can be carried by stormwater into adjacent surface waters and wetlands, affecting water clarity, oxygen content, and ultimately the survival of aquatic plants and animals.

The JEGS provide criteria for managing wastewater effluent and the quality of drinking water but do not specifically list water quality criteria for natural systems. General guidance for water resources is as follows:

JEGS 13-5.1 states, “where feasible, wetlands, floodplains and drainage ways should not be used for facilities development but should be used for open space and recreation” (U.S. Forces, Japan, 2004).

JEGS 13-5.2 states that to prevent the transport and discharge of silt into surface waters, installations should implement erosion and sediment control measures, to include use of vegetative cover, diversion drains, grading management, filter strips, and sediment basins.

The base SWPPP states “stormwater should not be intentionally routed to natural wetlands without pre-treatment due to the potentially damaging effects runoff can have on natural wetland systems. In addition, natural wetlands that receive stormwater should be evaluated to determine if the runoff is causing degradation of the wetland, and if so, measures should be taken to protect the wetland from further degradation and to repair any damage that has been done.”

### 4.2.2 Overview of Impacts

There are several potential means whereby the Proposed Action could pose significant harm to water resources. Stormwater runoff, perhaps the major issue, is water transported off of impervious (not penetrated by water) surfaces during rain events. As this water flows over cleared land, paved areas, and rooftops, it can pick up sediment, debris, nutrients, and contaminants, such as oil and grease. These pollutants are then transported into nearby water bodies where they can degrade the quality of the water body. Site preparation, including clearing of vegetation, leveling, paving, demolition, and building construction have the potential to

increase the rate and volume of stormwater runoff. Construction activities may result in accidental spills/leaks of oils, fuels, or solvents. These materials may potentially soak into the soil and migrate into groundwater.

#### **4.2.3 Proposed Action**

##### **Surface Waters**

No surface waters would be directly harmed at the Proposed Action construction and demolition area. Activities at the project area (building construction/demolition, use of existing facilities, etc.) fall within the oversight of the existing base SWPPP, and no change to the status quo with the amount of stormwater transported into surface waters is expected. The increase in impervious surface area because of the buildings and parking area is minimal in comparison to the total impervious surface area of the main base. Thus, no appreciable increase in stormwater runoff would occur. In order to prevent indirect significant harm due to erosion and sedimentation to surface waters downstream from this area, construction and stormwater management BMPs would need to be strictly utilized and maintained. The construction of a new BX facility and parking area would not result in significant harm to surface waters if construction and stormwater management BMPs are strictly utilized and maintained.

BMPs listed in Chapter 6 are required to prevent the degradation of surface water bodies.

#### **4.2.4 No Action Alternative**

The No Action Alternative would not result in harm to water resources. The action would not be implemented.

### **4.3 GEOLOGY AND SOILS**

#### **4.3.1 Significance Criteria**

Significance criteria for soils are discussed in Chapter 13 of the JEGS (U.S. Forces, Japan, 2004) and the KAB INRMP (U.S. Air Force, 2004). These criteria include guidelines for the prevention of soil erosion and implementation of proper sediment control practices for construction and vegetation removal activities for projects occurring on KAB. Action Item number 7 of the INRMP and JEGS Chapter 13 (Sections 3.9 and 5.2) require that standard soil erosion/sediment control practices be utilized to reduce dust emissions to the atmosphere, and to reduce sediment runoff to surface water resources. AAFES considers a project to have an adverse effect on soils if erosion were to occur due to a lack of proper erosion control measures.

#### **4.3.2 Overview of Impacts**

Areas mission activities potentially harm are surveyed or evaluated as part of the Air Force EIAP (AFI 72-7061). Mitigative measures are developed to avoid or minimize any potential harm. Defining these potential impacts aids project planners and managers in decision-making for relocation of a project site and help avoid delays necessitated by additional investigation and/or consultation. Section 13-3.9 of the JEGS recommends that, "Installations shall utilize protective

vegetative cover or other standard soil erosion/sediment control practices to control dust, stabilize sites and avoid silting of streams” (U.S. Forces, Japan, 2004).

AAFES does not consider this project as causing harm to soils if proper erosion control measures are put in place prior to the initiation of construction or earth moving activities. Proper measures include the use of silt screens, hay bales, vegetative cover over previously cleared earth, etc.

#### **4.3.3 Proposed Action**

The Proposed Action includes facility construction, demolition, and daily BX operations. Buildings 409 and 413 would be demolished and a new BX structure would be built southwest of these structures.

Construction of the proposed BX and vehicle parking area has the potential to harm soil stability through increased wind- and water-caused soil erosion affecting air and water quality. Should guidelines and management practices set forth in the JEGS and INRMP be followed during construction and project implementation, AAFES does not anticipate any harm to soil stability within the project area.

#### **4.3.4 No Action Alternative**

The No Action Alternative is included as a baseline. Under this alternative, the Proposed Action would not take place and AAFES would not construct the proposed BX. Under the No Action Alternative, AAFES does not expect any harm to geology and soils.

### **4.4 CULTURAL RESOURCES**

#### **4.4.1 Significance Criteria**

Significance criteria for cultural resources are discussed in Chapter 12 of the JEGS (U.S. Forces, Japan, 2004) and the KAB ICRMP (U.S. Air Force, 2004c). These criteria include guidelines for the protection and systematic investigation of cultural resources located on KAB. AAFES considers a project to have an adverse effect on cultural resources if it were to: affect structures at KAB of potential historic significance that are over 50 years in age, and younger Cold War structures considered exceptionally important; affect any property listed on the World Heritage List or on the applicable country's equivalent of the National Register of Historic Places; or involve action where personnel excavate disturb, harm, possess, sell, trade, or remove historic or cultural resources (including human remains) without permission of the host nation and installation commander. If not previously inventoried resources are discovered in the course of a DoD action, the newly-discovered items would be preserved and protected pending a decision on final disposition by the installation commander after coordination with the appropriate Japanese government officials.

#### 4.4.2 Overview of Impacts

There would be no significant harm to known cultural resources. Construction plans will be designed to avoid known cultural resources if practicable. A mitigation plan can be found in Appendix B of this document. AAFES would comply with recommended mitigations to avoid potential harm to identified significant cultural resources.

#### 4.4.3 Proposed Action

AAFES does not anticipate any harm to historic structures as a result of the Proposed Action. None of the structures identified for demolition are considered significant.

Construction activities at the proposed construction and demolition site have the potential to harm existing tomb sites through direct or indirect impacts. As a result, the Air Force conducted surveys to identify cultural resources and together with AAFES developed a mitigation plan to minimize significant harm to these resources. Specifically, in accordance with Section 12-3.8 of the JEGS, a cultural resources site review must be conducted prior to any construction activities. This site review includes the creation of a site plan displaying the proposed footprint of activities and proposed work needed to identify and evaluate any cultural resources illustrating the limit of construction and/or work required. Until a complete survey of operation sites has been accomplished, risk of direct physical harm to unknown cultural resources exists. Adherence to the mitigation plan (Appendix B) and to management practices set forth in the JEGS, ICRMP, and Chapter 6 of this ER will minimize and eliminate the risk of significant harm to cultural resources.

Following the completion of this survey and mitigation work, the subsequent discovery of undocumented cultural resources would force work on the Proposed Action to cease and the appropriate actions described in the Base ICRMP and JEGS would be followed. Inadvertent discoveries of cultural resources are covered under Section 12-3.9 of the JEGS and Sections 4.2.1, 4.2.2, 4.2.4, and 3.4 of the Base ICRMP (U.S. Forces, Japan, 2004) and are discussed in Chapter 6 of this document.

Particular tree species are considered culturally significant to the Okinawan people. These species include the banyan (*Ficus microcarpa* and *Ficus retusa*). Two banyan specimens are located near the boundaries of the proposed action. If avoidance is not practicable, relocation and replanting of these trees will occur if the Proposed Action would potentially harm them. During tree removal operations in the BX construction area, actions as outlined in the JEGS (U.S. Forces, Japan, 2004) will be used to avoid and minimize harm to these cultural resources.

#### 4.4.4 No Action Alternative

The No Action Alternative is included as a baseline and means that the Proposed Action would not take place and that AAFES would not construct the new BX facility. Under the No Action Alternative no harm to cultural resources is expected.



## 4.5 BIOLOGICAL RESOURCES

### 4.5.1 Significance Criteria

Significance criteria are presented for wildlife and vegetation, and for those species designated at risk for extinction by the prefecture RDB or Japan RDB. The JEGS provides guidance on significance criteria.

JEGS 13-5.6 states trees and forestry plantings should not be “carelessly destroyed” and that woodland management should consider a balance of needs between natural resources, military and recreational uses (U.S. Forces, Japan, 2004).

JEGS 13-3.1 states “Installations shall take reasonable steps to protect and enhance known or endangered or threatened species and host nation protected species and their habitat.”

For the purposes of analysis, harming, killing, or displacing an RDB listed species is considered significant. Mitigations would be required for these situations.

### 4.5.2 Overview of Impacts

Impact from the proposed action are expected to be minimal should recommended mitigation be followed. AAFES has developed a companion mitigation plan (Appendix B) for biological resources within the project areas and would comply with recommended mitigations concerning the Proposed Action to avoid potential harm to identified biological resources.

### 4.5.3 Proposed Action

The Proposed Action encompasses a total of 31.53 acres, of which the majority of acres (greater than 75 percent) is open space or disturbed. The remainder of the project area is within a heavily vegetated gully.

In order to make an accurate determination of significant harm resulting from the Proposed Action, AAFES conducted a natural resources survey of the project site prior to any construction. As a result of this survey, it is suggested that construction of the new BX facility would potentially impact two specimens of *Bishofia javanica*. As a general reference, trees that measure 150 cm in diameter at chest height should be recommended for preservation and protection to maintain the natural environment and beautify the area (Komine, 2007a). Both of the specimens of *Bishofia javanica* within the project area are less than 150 cm in diameter. As per the findings of the Mitigation plan, AAFES does not anticipate any significant harm and does not expect protected species of sufficient size to be affected by the proposed action.

### 4.5.4 No Action Alternative

The No Action Alternative would not result in significant harm to plants or wildlife, including protected species.

## **5. CUMULATIVE IMPACTS AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES**

### **5.1 PAST AND PRESENT ACTIONS RELEVANT TO THE PROPOSED ACTION AND ALTERNATIVES**

The General Plan for the installation outlines Capital Improvement Projects (CIPs) and land use allocations for projected new developments and redevelopment of facilities. The General Plan addresses land use and an evaluation of facilities in the North and South Ramp Areas. The North Ramp Area contains the majority of airfield pavement on the installation and is primarily used to house wide bodied aircraft. The General Plan addresses the need to maintain the capability in the North Ramp Area of housing and maintaining wide bodied aircraft.

The base has long-term plans to develop a Fuel Cell Hangar, Corrosion Control Hangar, Two-Bay Maintenance Dock, and Helicopter Hangar Rescue Facility in the North Ramp Area. Also planned in the North Ramp Area is the conversion of all asphalt to concrete on the airfield paved areas. The installation has long-term future plans to consolidate facilities in the South Ramp Area to conduct operational, command and administrative functions. The consolidation of command and control facilities in the South ramp area will allow the clearing of space for more airfield pavements in the North Ramp Area to accommodate a surge of aircraft.

In addition to the described activities in the General Plan, there are potential military construction (MILCON) projects which include the construction of a Mobility Center and Weapons Readiness Materiel Storage Facility on KAB property, the replacement of the Chapel center from an already existing structure and the construction of a fully contained Combat Arms Training Range (CATM Range).

### **5.2 REASONABLY FORESEEABLE FUTURE ACTIONS THAT INTERACT WITH THE PROPOSED ACTION**

Reasonably foreseeable future actions include the withdrawal of U.S. Marines from Okinawa.

The headquarters of the III Marine Expeditionary Force (III MEF) will be relocated to Guam and other locations and the remaining Marine units in Okinawa will be realigned and reduced into a Marine Expeditionary Brigade (MEB). This realignment in Okinawa will include the transfer of approximately 7,000 Marine officers and enlisted personnel, plus dependents out of Okinawa. These transferred personnel will come from units in each of the elements of Marine capability (air, ground, logistics, and command), including portions of the Marine Air Wing, the Force Service Support Group, and the 3d Marine Division. (U.S. Department of State, 2005).

### **5.3 ANALYSIS OF CUMULATIVE IMPACTS**

The following resources were evaluated for potential cumulative harm.

#### **5.3.1 Air Quality**

The Air Force anticipates that the General Plan and MILCON activities will require construction and some demolition efforts. The construction and demolition efforts will increase air emissions but these increases will be short term in duration and the Air Force does not anticipate a significant impact on air quality.

A classified project will increase air emissions but these increases will not exceed the threshold criteria established by the ER.

The realignment of the III MEF to Guam will reduce a significant amount of emissions from the area and would improve air quality based on the reduction of emissions sources.

#### **5.3.2 Water Resources**

Cumulative impacts on water resources within the project area are related to surface water susceptible to stormwater runoff from soil disturbance. Multiple construction projects will require erosion control measures to limit the amount of construction site sediment, debris and contaminants that can be transported into surface waters. Prevention of significant cumulative impacts would require implementation of and strict adherence to BMPs.

#### **5.3.3 Geology and Soils**

Several future projects involve the conversion of all airfield paved areas from asphalt to concrete. Due to the existing paved conditions of the soil, such a conversion is not expected to harm soils in the North Ramp area. Other plans such as development of a Fuel Cell Hangar, Corrosion Control Hangar, Two-Bay Maintenance Dock, Helicopter Hangar Rescue Facility, and clearing of space for more airfield pavements all in the North Ramp Area may involve actions such as construction, excavation, and land clearing.

Ground disturbance from these projects as well as the proposed action have the potential to affect soil stability and to increase soil runoff into local streams, drainages and water bodies. If BMPs are followed, regarding soil stabilization and subsequent planting of vegetation, AAFES would not expect any potential contribution to cumulative impacts of soil erosion.

#### **5.3.4 Cultural Resources**

Potential MILCON construction projects include the construction of a Mobility Center and Weapons Readiness Materiel Storage Facility on KAB property, the replacement of the Chapel center from an already existing structure and the construction of the CATM Range. As with the proposed action and any construction, the surrounding area must be tested and evaluated for any significant cultural resources. Until a complete survey of the area has been completed, the danger of direct physical harm to unknown cultural resources is a possibility.

### **5.3.5 Biological Resources**

MILCON projects and the Proposed Action could result in a net loss of forested or vegetated habitats but in different areas. Listed MILCON projects and the Proposed Action occur within existing main base areas. AAFES will comply with recommended mitigations concerning the Proposed Action to avoid potential harm and avoid a cumulative harm to biological resources. The addition of proposed MILCON projects retains the potential to present cumulative harm to biological resources.

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## 6. MANAGEMENT REQUIREMENTS

### 6.1 AIR QUALITY

- Dust suppression activities should be implemented during the demolition and construction activities.

### 6.2 WATER RESOURCES

- Entrenched silt fencing and staked hay bales or sediment dams would be installed and maintained along the perimeter of the construction site prior to any ground-disturbing activities as per the JEGS (Table 4-6).
- Entrenched silt fencing or staked hay bales would be installed and maintained along the perimeter of demolition debris stockpile areas.
- Demolition debris stockpiles would be removed in a timely manner.
- Waste receptacles, including dumpsters, would be covered to prevent rainwater from entering as per the JEGS (Table 4-6).
- Drinking water and wastewater collection/transmission lines would be properly abandoned during demolition of existing facilities.
- The aforementioned BMPs would be inspected and maintained to ensure effectiveness.
- Wetlands should be avoided and a 100-foot minimum vegetative buffer should be left in between cleared areas and wetland areas.

### 6.3 SOIL RESOURCES

Section 13-3.9 of the JEGS recommends that, “Installations shall utilize protective vegetative cover or other standard soil erosion/sediment control practices to control dust, stabilize sites and avoid silting of streams” (U.S. Forces, Japan, 2004).

- Silt fencing, staked hay bales, or sediment dams would be inspected on a weekly basis and after rain events. It would be replaced as needed.
- Cleared areas would be vegetated or treated with other erosion control techniques once final grade has been established.

### 6.4 CONSTRUCTION-RELATED MANAGEMENT REQUIREMENTS

- Contact 718 CES/CEV Hazardous Waste Program Manager (HWPM) about all hazardous materials used in construction projects. All paints, solvents and adhesives must be approved, documented, and tracked. 718 CES/CEV manages the base hazardous waste management program (HWMP) and ensures compliance with JEGS and applicable AFIs that apply to wastes base activities generate. In addition, the HWPM ensures that

contracted services comply with environmental standards and instructions. This is discussed in Section 2.7.3 of the HWMP 544 (U.S. Air Force, 2004).

- Adhere to management requirements and guidelines outlined within the JEGS Chapters 5, 6, and 7. Also follow associated regulations and KAB's HWMP 544 (U.S. Air Force, 2004).
- Contact 718 CES/CEV HWPM if unusual soil coloration and/or odors are detected and if small arms debris is found in these construction locations.
- When renovating or demolishing structures, fluorescent light bulbs should be handled according to the HWMP 544, Section 2.7.3.1 (U.S. Air Force, 2004). The responsible party for waste materials in buildings to be demolished would transport the fluorescent bulbs to the Hazardous Waste Storage Area (HWSA) bulb crusher in a way that would assure no leakage to the environment and would follow the listed procedures for crushing the bulbs.
- If aerosol cans are to be discarded, place the can into an area labeled "Waiting turn-in to HazMart." The user then must contact HazMart for proper turn-in procedures. Details for this process can be found in Section 2.7.3.2 of the HWMP 544 (U.S. Air Force, 2004).
- Contact Explosive Ordnance Disposal (EOD) immediately upon discovery of any Unexploded Ordnance (UXO) or suspected UXO items while digging.
- Where applicable, existing community labor force and local contractors would be used for construction elements of the Proposed Action.

## 6.5 CULTURAL RESOURCES

- Known cultural resources are to be avoided when practicable. In accordance with Section 12-3.8 of the JEGS; analysis, survey, mitigation, or other appropriate treatment must be afforded to areas that major construction activity could potentially affect. A mitigation plan can be found in Appendix B of this document. AAFES will comply with recommended mitigations concerning the Proposed Action to avoid potential harm to identified significant resources.
- Shrines, tombs, or other such family-oriented sites would be mitigated/ evaluated in close consultation with project subject matter expert, cultural resource manager and any consanguine relations that can be located/contacted in the area.
- Prefecture protected tree and flower species such as the Taiwan cherry (*Prunus campanulata*), diego (*Erythrina orientalis*), and banyan (*Ficus microcarpa* and *Ficus retusa*) are considered culturally significant and should be afforded proper treatment. Relocation and replanting of these species may be required if the proposed actions threaten these resources.
- Inadvertent discoveries of cultural resources are covered under Section 12-3.9 of the JEGS and Sections 4.2.1, 4.2.2, 4.2.4, and 3.4 of the Base ICRMP. Under these regulations, should an unintended discovery of cultural resources occur, all construction shall cease, the cultural resource manager shall be informed immediately of the discovery and the general area be secured from further disturbance. If human remains are

discovered during the course of implementing the Proposed Action, Table 12.2 of the JEGS recommends the same course of actions.

## 6.6 BIOLOGICAL RESOURCES

- Plant species suitable for landscaping should be salvaged from operation sites and relocated to a temporary nursery for later use.
- AAFES would transplant existing Banyan Trees if practicable from the proposed construction sites to appropriate new areas.
- AAFES would consult the Biological and Cultural Resources Mitigation Plan (Appendix B) for this ER to identify specific locations of protected species within the construction area. AAFES would first consider avoidance of protected species and their habitat as a mitigation strategy. Mitigation strategies to be utilized include alteration of site footprint to create the least disruptive alignments. If species cannot be avoided, AAFES would consider relocation of the species.
- Where takes of protected species are unavoidable, AAFES and the Air Force would coordinate as required with the appropriate host nation agency.



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**APPENDIX A**

**AIR QUALITY**



## AIR QUALITY

This appendix presents an overview of the emission factor development and calculations including assumptions employed in the air quality analyses.

### Project Calculations

#### Construction Emissions

Construction emissions calculations were completed using the calculation methodologies described in the U.S. Air Force Air Conformity Applicability Model (ACAM). The ACAM evaluates the individual emissions from different sources associated with the construction phases. These sources include grading activities, asphalt paving, construction worker trips, stationary equipment (e.g. saws and generators), non-residential architectural coatings and mobile equipment emissions (U.S. Air Force, 2003).

#### Grading Activities

Grading activities are divided into grading equipment emissions and grading operation emissions. Grading equipment calculations are combusive emissions from equipment engines and are ascertained in the following manner:

$$\text{VOC} = .22 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

$$\text{NO}_x = 2.07 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

$$\text{PM}_{10} = .17 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

$$\text{CO} = .55 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

$$\text{SO}_2 = .21 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

Where:

Acres = Number of gross acres to be graded during Phase I construction.

DPY<sub>1</sub> = Number of days per year during Phase I construction which are used for grading.

2000 = Conversion factor from pounds to tons.

All emissions are represented as tons per year.

Grading operations are calculated using a similar equation from the Sacramento Air Quality Management District and the South Coast Air Quality Management Districts (U.S. Air Force, 2003). These calculations include grading and truck hauling emissions.

$$\text{PM}_{10} \text{ (tons/yr)} = 60.7 \text{ (lbs/acre/day)} * \text{Acres} * \text{DPY}_1 / 2000$$

Where:

Acres = Number of gross acres to be graded during Phase1 construction.

DPY<sub>1</sub> = Number of days per year during Phase I construction which are used for grading.

2000 = Conversion factor from pounds to tons.

Calculations used in the ER assumed that there were no controls used to reduce fugitive emissions. Emissions factors were derived from the Sacramento Air Quality Management District and the South Coast Air Quality Management District (U.S. Air Force, 2003).

### Architectural Coatings

Non-residential architectural coating emissions are released through the evaporation of solvents that are contained in paints, varnishes, primers and other surface coatings.

$$\text{VOC}_{\text{SF}} (\text{lbs/yr}) = (\text{SQR\_GRSQF} * 1.63) / 2000$$

Where:

SQR\_GRSQF = Square root of gross square feet of non-residential building space to be constructed in the given year of construction.

1.63 = Emissions factor.

2000 = Conversion factor from pounds to tons.

Emissions factors were derived from the Sacramento Air Quality Management District and the South Coast Air Quality Management District (U.S. Air Force, 2003).

### Asphalt Paving

VOC emissions are released during asphalt paving and are calculated using the following methodology:

$$\text{VOC}_{\text{PT}} (\text{tons/yr}) = (2.62 \text{ lbs/acre}) * \text{Acres Paved} / 2000.$$

Acres Paved = Total number of acres to be paved at the site.

2000 = Conversion factor from pounds to tons.

The specific emissions factors used in the calculations were available through Sacramento Air Quality Management and the South Coast Air Quality Management Districts (U.S. Air Force, 2003).

Construction Worker Trips

Construction worker trips during the construction phases of the project are calculated and represent a function of the square feet of commercial construction.

$$\text{Trips (trips/day)} = .42 \text{ (trip/unit/day)} * \text{Area of training facilities.}$$

Total daily trips are then applied to the following factors depending on the corresponding years.

Year 2005 through 2009:

$$\text{VOC}_E = .016 * \text{Trips}$$

$$\text{NOx}_E = .015 * \text{Trips}$$

$$\text{PM}_{10}_E = .0022 * \text{Trips}$$

$$\text{CO}_E = .262 * \text{Trips}$$

Year 2010 and beyond:

$$\text{VOC}_E = .012 * \text{Trips}$$

$$\text{NOx}_E = .013 * \text{Trips}$$

$$\text{PM}_{10}_E = .0022 * \text{Trips}$$

$$\text{CO}_E = .262 * \text{Trips}$$

To convert from pounds per day to tons per year:

$$\text{VOC (tons/yr)} = \text{VOC}_E * \text{DPY}_{II}/2000$$

$$\text{NO}_x \text{ (tons/yr)} = \text{NOx}_E * \text{DPY}_{II}/2000$$

$$\text{PM}_{10} \text{ (tons/yr)} = \text{PM}_{10}_E * \text{DPY}_{II}/2000$$

$$\text{CO (tons/yr)} = \text{CO}_E * \text{DPY}_{II}/2000$$

Where:

Commercial construction = Total square footage of commercial aviation park to be constructed in the given year of construction.

2000 = Conversion factor from pounds to tons.

$\text{DPY}_{II}$  = Number of days per year during Phase II construction activities.

It was assumed that the total square footage of construction was estimated to be 302,730 square feet. Emissions factors were derived from the Sacramento Air Quality Management District and the South Coast Air Quality Management District (U.S. Air Force, 2003).



Stationary Equipment

Emissions from stationary equipment occur when gasoline powered equipment (e.g. saws, generators, etc.) is used at the construction site.

$$\text{VOC} = .198 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{NO}_x = .137 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{PM}_{10} = .004 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{CO} = 5.29 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{SO}_2 = .007 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

Where:

GRSQF = Gross square feet of commercial buildings to be constructed during Phase II.

DPY<sub>II</sub> = Number of days per year during Phase II construction.

2000 = Conversion factor from pounds to tons.

Emissions factors were derived from the Sacramento Air Quality Management District and the South Coast Air Quality Management District (U.S. Air Force, 2003).

Mobile Equipment

Mobile equipment emissions include pollutant releases associated with forklifts, dump trucks, etc., used during Phase II construction.

$$\text{VOC} = .17 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{NO}_x = 1.86 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{PM}_{10} = .15 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{CO} = .78 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

$$\text{SO}_2 = .23 * (\text{GRSQFT}) * \text{DPY}_{\text{II}} / 2000$$

Where:

GRSQF = Gross square feet of training area to be constructed during Phase II.

DPY<sub>II</sub> = Number of days per year during Phase II construction.

2000 = Conversion factor from pounds to tons.

Emissions factors were derived from the Sacramento Air Quality Management District and the South Coast Air Quality Management District (U.S. Air Force, 2003).

## **APPENDIX B**

### **BIOLOGICAL AND CULTURAL RESOURCES MITIGATION PLAN**



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## LIST OF ACRONYMS

<b>AAFES</b>	Army and Air Force Exchange Service
<b>AB</b>	Air Base
<b>BX</b>	Base Exchange
<b>JEGS</b>	Japan Environmental Governing Standards
<b>KAB</b>	Kadena Air Base

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## B.1 INTRODUCTION

In support of the construction of the new Base Exchange (BX), at Kadena Air Base (KAB), Okinawa, Japan, the Army and Air Force Exchange Service (AAFES) authorized a threatened and endangered species survey, and the Air Force (Kadena AB Environmental Flight) concurrently authorized a cultural resources survey of the project area (Figure B-1). The surveys were conducted in support of an Environmental Review for the construction of new BX (Figure B-2) to mitigate potential impacts to threatened and endangered species and cultural resources. Construction actions at the BX project area would entail potential tree and stump removal and replanting as well as potential burying or avoidance of existing cultural features. The total area under consideration for development is 31.53 acres.

Garcia and Associates, Kailua, Hawaii, under direction from Science Applications International Corporation, conducted the biological reconnaissance survey on 26–27 February 2007. The survey team was composed of four biological species experts from the Institute of Tropical Plants and Environment, Ga-Show Consulting, and Garcia and Associates (Minton, 2007). A concurrent cultural resource survey is being conducted by host nation contractors at the direction of the Air Force (Kadena AB Environmental Flight).

The surveys comply with Japan Environmental Governmental Standards (JEGS) Criterion 12-3.8 that requires installations to conduct analysis of proposed project sites to determine the presence or absence of significant cultural resources and to document these resources (U.S. Forces, Japan, 2006). The biological survey was conducted to document any threatened and endangered species identified in JEGS Chapter 13 (U.S. Forces, Japan, 2006) and in the *Integrated Natural Resources Management Plan* for KAB (U.S. Air Force, 2004). Detailed results of the biological and cultural surveys can be found in Chapters 3, 4, and Appendix E of the associated Environmental Review document.

This document briefly summarizes the findings and presents recommended mitigations and/or AAFES project revisions resulting from the surveys.

### B.1.1 CULTURAL RESOURCE SUMMARY

The cultural resource survey is currently in progress and is expected to be completed by the end of June 2007. This work is being closely monitored by Kadena's Environmental Office and the local Board of Education. The cultural resource work in the project area included a pedestrian inspection of the gully spaced with limited subsurface testing to examine for the presence of cultural features and tomb complexes (Figures B-3 through B-5). Cultural sites, when recorded, were analyzed and photographed, and feature and artifact locations were noted in detail.

#### B.1.1.1 Findings

The cultural resource survey identified two archaeological tomb sites. At the time of the site visit, all overburden had been cleared away from the tombs, and artifacts had been flagged and documented in their original location. Relatives associated with these family tombs were contacted and consultations with these families had progressed. These efforts are currently being monitored by the base Environmental Office and the local Board of Education.

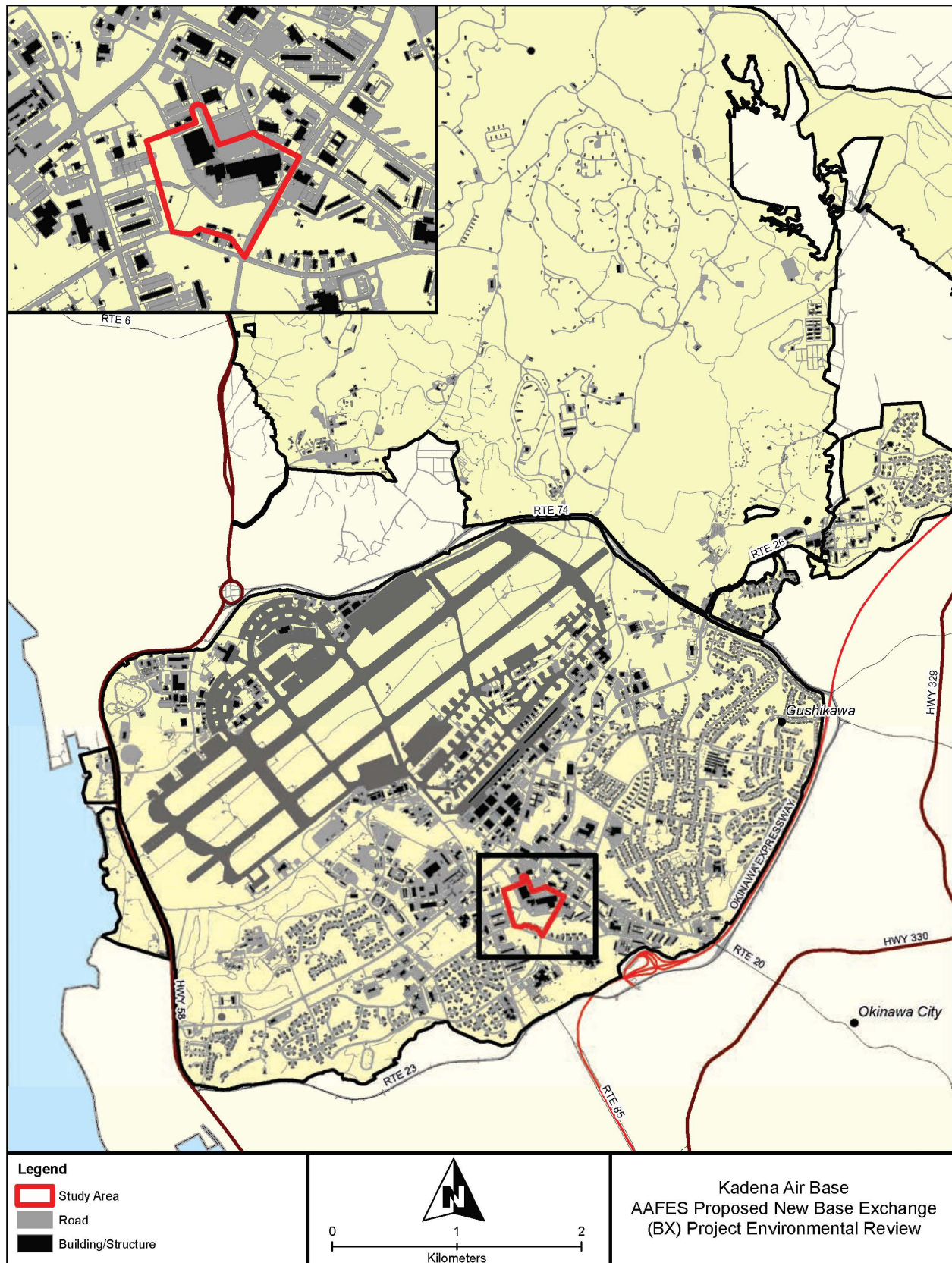


Figure B-1. Proposed Project Area



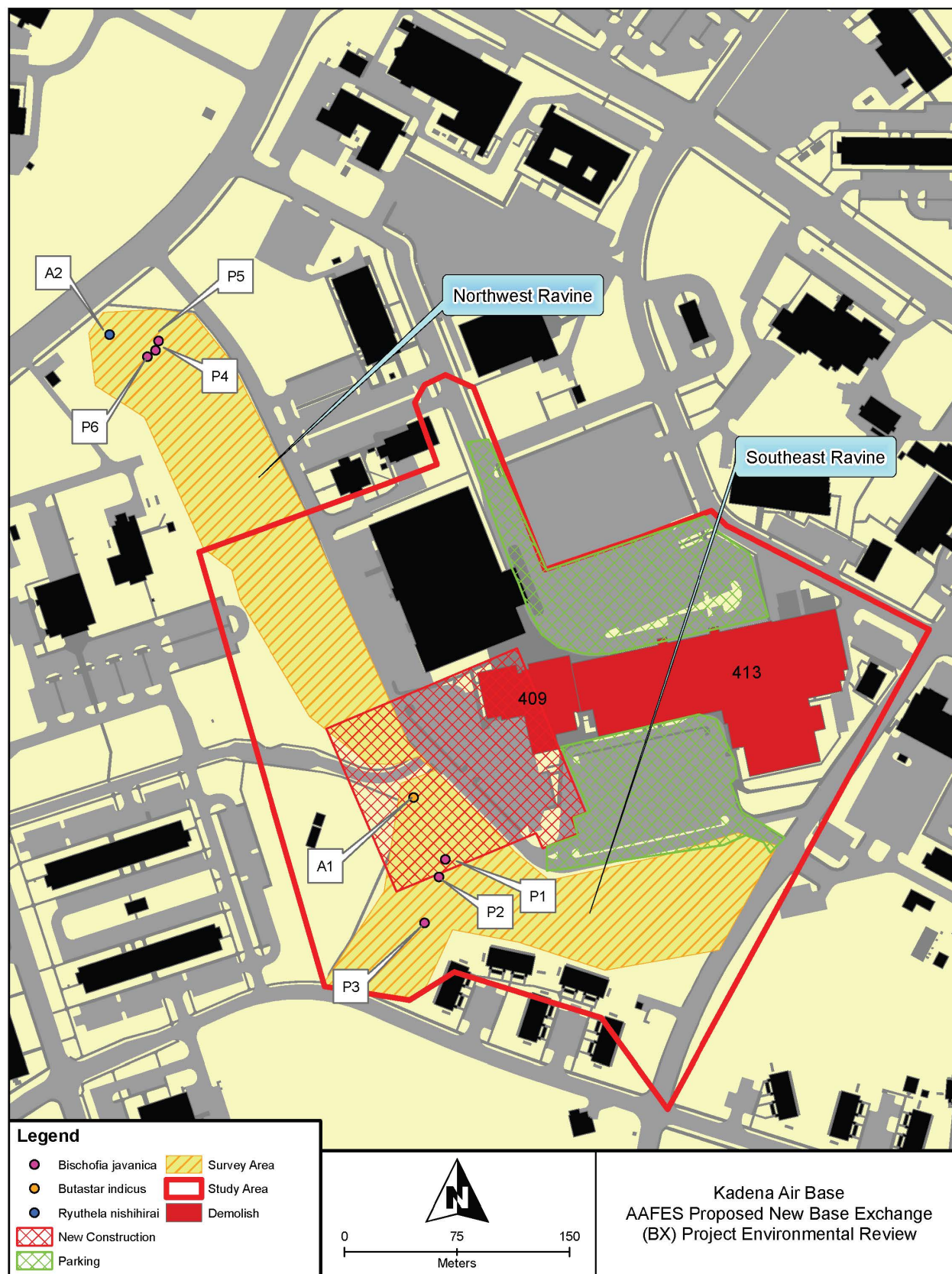


Figure B-2. Proposed Action Area Resources



These tomb sites are recommended as significant cultural resources. At present, they have the potential to yield information regarding traditional interment methods on Okinawa and hold cultural significance to the local populace. The current field effort is in progress and is expected to be completed by the end of June 2007.

## B.1.2 THREATENED AND ENDANGERED SPECIES SUMMARY

Wildlife and botanical surveys were conducted to confirm the presence of special status species within the survey sites as required under JEGS and the *Integrated Natural Resource Management Plan* for KAB. The field surveys were guided by examination of regional literature and aerial photography of the study areas to determine the most probable habitats for species of concern. As a result, two sections of wooded ravine located west of Seville Avenue were examined as suitable habitat. Surveyors conducted a walking survey of these sections of the ravine (Minton, 2007).

### B.1.2.1 Findings

Relatively few wildlife observations were made within this survey area. One tree species, *Bishofia javanica*, was noted in six locations. One special status bird, the gray-faced buzzard eagle (*Butastur indicus*), and one special status arachnid, a colony of the Okinawan Kimura's trap door spiders (*Ryuthela nishihirai*), were also noted in the survey area. Both of these species are considered vulnerable; however, the gray-faced buzzard eagle is a winter migratory species that does not annually inhabit this area, and the Okinawan Kimura's trap door spiders and three of the *Bishofia javanica* were documented outside of the project area (Minton, 2007).



**Figure B-3. Cultural Resource Survey Work**  
(looking southwest; note Banyan trees in foreground and background)





**Figure B-4. Work on Tomb Site During Cultural Resource Survey (Looking West)**



**Figure B-5. Work on Tomb Site During Cultural Resource Survey (Looking South)**

## **B.2 MITIGATIONS**

This chapter identifies the project area and discusses whether the Proposed Action may cause a significant impact to the environment. Also identified are the mitigating actions required of the proponent (AAFES) to reduce or eliminate such adverse impacts to threatened or endangered species and cultural resources. In the case of subsequent inadvertent discoveries, the construction contractor will cease work and immediately contact the Base Conservation Manager, 718 CES/CEV (634-2132).

### **B.2.1 BASE EXCHANGE PROJECT AREA**

The BX project area is located within the main cantonment area of KAB (Figure B-1). The area has been extensively developed in the past and consists of housing areas and the existing BX complex and associated shopping and service areas. The portion of the project area located west of Seville Avenue contains a wooded ravine and active watercourse (Figure B-2).

#### **B.2.1.1 Cultural Resources**

Two existing tombs are situated near the far southern edge of the new construction footprint. The tomb complex, a recommended significant resource, is located near the boundaries of the Proposed Action area. Because of the potential for direct and indirect impacts due to the proposed development, mitigative actions will be required to protect these resources. It is the preferred course of action that these tombs be preserved in place.

#### **B.2.1.2 Mitigation Actions for Cultural Resources**

- AAFES will preserve the ravine area along the southern and western boundary of the project area as much as practicable during design, construction, and subsequent operation activities.
- AAFES and/or the designated construction contractor will preserve in place the tomb complex on the eastern edge of the project area during the course of construction activities.
- Construction site runoff will be diverted through best management practices to prevent sediments from entering the ravine areas and indirectly affecting cultural resources.
- AAFES will provide for an on-site archaeologist to periodically monitor the construction site for adherence to management plans, new discoveries, etc.
- Any changes in the current design that may cause impacts to cultural resources will require additional archaeological survey.
- The two Banyan trees that are superimposed over the tomb complex (Figure B-3) are considered culturally significant resources to the communities around Kadena AB. As such, they will be considered for removal and transplant to another site should they be threatened with impact from construction activity. Moving the trees during flowering and fruiting season should be avoided.

### B.2.1.3 Natural Resources

The wildlife surveys identified two species with special status in the survey area: the gray-faced buzzard eagle (*Butastur indicus*) and a colony of the Okinawan Kimura's trap door spiders (*Ryuthela nishihirai*). *Butastur indicus* is a migratory species and, as such, no mitigations are required. *Ryuthela nishihirai* was noted outside of the current construction footprint and is not expected to be disturbed by construction or demolition activities. No mitigation activity is required for the *Ryuthela nishihirai* colony.

*Bishofia javanica* trees were noted in six locations, two of which were within project construction boundaries and four of which were located well outside the proposed construction area (Minton, 2007). As a general reference, trees that measure 150 cm in diameter at chest height should be recommended for preservation and protection to maintain the natural environment and to beautify the area. Both of the specimens within the project area are less than 150 cm in diameter. As a result of their smaller size, the two *Bishofia javanica* located within the construction footprint (labeled P1 and P2 on Figure B-2) will not require any specific mitigation.

### B.2.1.4 Mitigation Actions for Natural Resources

- AAFES will preserve the ravine area along the southern and western boundary of the project area as much as practicable during construction and subsequent operation activities. This includes avoidance activities in vegetated portions of the ravine such as:
  1. No staging or storage of construction equipment or building materials in this area.
  2. No entry into this area of vehicles or heavy equipment except for those directly involved in the construction.
  3. No work conducted in the area of special status species prior to any removal or replanting.

### **B.3 REFERENCES**

- Minton, J., 2007. Natural Resource Survey of the Kadena Base Exchange Expansion Project Area Kadena Air Base, Okinawa Prefecture, Japan. Prepared for Scientific Applications International Corporation, Shalimar, Florida. Prepared by Garcia and Associates, 1512 Franklin Street, Suite 100, Oakland, California 94612.
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## **APPENDIX C**

### **RED DATA BOOK ANIMAL SPECIES FOR OKINAWA**



## RED DATA BOOK ANIMAL SPECIES FOR OKINAWA

Table C-1. Red Data Book Animal Species Potentially Occurring on Okinawa

Status	Japanese Name	Scientific Name	English Name
<b>MAMMALS</b>			
EX	Okinawa Ookoumori	<i>Pteropus loochoensis</i>	Okinawa flying fox
CR		<i>Tokudaia osimensis muenninki</i>	Okinawa spinous country -rat
NT	Watasejinezumi	<i>Crocidura horsfieldi watasei</i>	Watase's shrew
NT	Hiwamizuramogura	<i>Euroscaptor mizura hiwaensis</i>	N/A
<b>BIRDS</b>			
CR	Noguchigera	<i>Sapheopipo noguchii</i>	Pryer's woodpecker
CR	Usuakahige	<i>Erithacus komadori subrufus</i>	Ryukyu robin
EN	Kinbato	<i>Chalcophaps indica yamashinai</i>	Emerald dove
EN	Mosukemisozai	<i>Troglodytes troglodytes mosukei</i>	N/A
VU	Aotsurakatsuodori	<i>Sula dactylatra personata</i>	N/A
VU	Ryukyutsumi	<i>Accipiter gularis iwasakii</i>	N/A
VU	Ookuina	<i>Rallina eurizonoides sepiaria</i>	Banded crane
VU	Ryukyu Ookonohazuku	<i>Otus bakkamoena pryeri</i>	N/A
VU	Hontou Akahige	<i>Erithacus komadori namiyei</i>	Ryukyu robin
NT	Beniajisashi	<i>Sterna dougallii bangsi</i>	N/A
NT	Karasubato	<i>Columba janthina janthina</i>	Japanese wood pigeon
VU	Hontou Akahige	<i>Erithacus komadori namiyei</i>	Ryukyu robin
NT	Beniajisashi	<i>Sterna dougallii bangsi</i>	N/A
NT	Karasubato	<i>Columba janthina janthina</i>	Japanese wood pigeon
<b>REPTILES</b>			
CR	Iheyatokagemodoki	<i>Goniurosaurus kuroiwaie toyamai</i>	Toyama's ground gecko
CR	Kikuzatosawahebi	<i>Opisthotropis kikuzatoi</i>	Kikuzato's brook- snake
EN	Madaratokagemodoki	<i>Goniurosaurus kuroiwaie orientalis</i>	Spotted ground gecko
EN	Yamashina	<i>Goniurosaurus kuroiwaie</i>	Yamashina's
	Tokagemodoki	<i>Yamashinae</i>	Ground gecko
VU	Ryukyuyama Game	<i>Geomyda spengleri japonica</i>	Yanbarugame
VU	Kurokwatokagemodoki	<i>Eublepharis kuroiwaie</i>	Kuroiwa's ground gecko
VU	Kinobori Tokage	<i>Japalura polysonata polygonata</i>	Okinawan tree lizard
VU	Baabaa Tokage	<i>Eumeces barbouri</i>	Barbour's blue-tailed skink
VU	Miyako Tokage	<i>Emoia atrocostata atrocostata</i>	Coastal skink
VU	Miyako Hibaa	<i>Amphiesma concolorum</i>	Miyako keelback snake
VU	Yonaguni Syuuda	<i>Elaphe carinata yonaguniensis</i>	Yonaguni musk snake
VU	Miyara Himehebi	<i>Calamaria pavementata miyarai</i>	Miyara's dwarf snake
NT	Hyan	<i>Calliophis japonicus</i>	Japanese coral snake
NT	Hai	<i>Hemibungarus japonicus boettgeri</i>	Okinawan coral snake
DD	Suppon	<i>Trionyx sinensis wiegmanni</i>	Chinese soft-shelled turtle
<b>AMPHIBIANS</b>			
EN	Ishikawagaeru	<i>Rana ishikawae</i>	Ishikawa's frog
VU	Iboimori	<i>Tylototriton andersoni</i>	Anderson's
			Alligator newt
VU	Hanasaki Gaeru	<i>Rana narina</i>	Ryukyu tip-nosed Frog



Table C-1. Red Data Book Animal Species Potentially Occurring on Okinawa Cont'd

Status	Japanese Name	Scientific Name	English Name
VU	Namiegaeru	<i>Rana namiyei</i>	Namiye's frog
VU	Horusutogaeru	<i>Babina holsti</i>	Holst's frog
NT	Shiriken Imori	<i>Cynops ensicauda</i>	Sword-tailed newt
<b>FISH</b>			
CR	Taiwankingyo	<i>Macropodus opercularis</i>	N/A
LP	Taunagi	<i>Monopterus albus</i>	N/A
LP	Masago Haze	<i>Pseudogobius masago</i>	N/A
LP	Tobihaze	<i>Periophthalmus modestus</i>	N/A

CR = Critically Endangered; DD = Data Deficient; EN = Endangered; LP = Local Population; N/A = Not Available;  
NT = Near Threatened; VU = Threatened Vulnerable

## **APPENDIX D**

### **REQUEST FOR ENVIRONMENTAL IMPACT ANALYSIS**



REQUEST FOR ENVIRONMENTAL IMPACT ANALYSIS		Report Control Symbol RCS: <del>35</del> CEV-06-017
INSTRUCTIONS: Section I to be completed by Proponent; Sections II and III to be completed by Environmental Planning Function. Continue on separate sheets as Necessary. Reference appropriate item numbers.		
<b>SECTION I - PROPONENT INFORMATION</b>		
1. TO (Environmental Planning Function) 718 CES/CEV Attn: George Komine Kadena AB, Japan	2. FROM (Proponent organization and functional address symbol) HQ AAFES (RE-E)	2a. TELEPHONE NO. DSN967-2109 (214)312-2109
3. TITLE OF PROPOSED ACTION Construct New Shopping Center Complex PN # 6445-03-000015		
4. PURPOSE AND NEED FOR ACTION (Identify decision to be made and need date) The Kadena Main Store is fragmented, has inadequate size for sales and storage. Parking and food concessions are also inadequate to serve the military community and retired personnel.		
5. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (DOPAA) (Provide sufficient details for evaluation of the total section.) To construct a new 330,438 SF two story shopping Center Complex to encompass the Main Store, two Food Courts, MCS and the Concession Mall to provide for one-stop shopping. The proposed Complex is to be located at the existing location bld # 409 & 413 on previously developed land between Seville Ave & Rickonbaker Rd.		
6. PROPONENT APPROVAL (Name and Grade) JAMES E. HUBBARD, Lt Col, USAF Chief, Environmental Division	6a. SIGNATURE <i>James E. Hubbard</i>	6b. DATE 24 Feb 06
<b>SECTION II PRELIMINARY ENVIRONMENTAL SURVEY.</b> (Check appropriate box and describe potential environmental effects including cumulative effects.) (+ = positive effect; 0 = no effect; - = adverse effect; U = unknown effect)		
7. AIR INSTALLATION COMPATIBLE USE ZONE/LAND USE (Noise, accident potential encroachment, etc.)		X
8. AIR QUALITY (Emission, attainment status, state implementation plan, etc.)		X
9. WATER RESOURCES (Quality, quantity, source, etc.)		X
10. SAFETY AND OCCUPATIONAL HEALTH (Asbestos/radiation/chemical exposure, explosives safety quantity-distance, etc.)		X
11. HAZARDOUS MATERIALS/WASTE (Use/storage/generation, solid waste, etc.)		X
12. BIOLOGICAL RESOURCES (Wetlands/floodplains, flora, fauna, etc.)		X
13. CULTURAL RESOURCES (Native American burial sites, archeological, historical, etc.)		X
14. GEOLOGY AND SOILS (Topography, minerals, geothermal, Installation Restoration Program, seismicity, etc.)		X
15. SOCIOECONOMIC (Employment/population projections, school and local fiscal impacts, etc.)		X
16. OTHER (Potential impacts not addressed above.)		
<b>SECTION III - ENVIRONMENTAL ANALYSIS DETERMINATION</b>		
17. <input checked="" type="checkbox"/> PROPOSED ACTION QUALIFIES FOR CATEGORICAL EXCLUSION (CATEX) # _____; OR <input type="checkbox"/> PROPOSED ACTION DOES NOT QUALIFY FOR A CATEX, FURTHER ENVIRONMENTAL ANALYSIS IS REQUIRED		
18. REMARKS		
19. ENVIRONMENTAL PLANNING FUNCTION CERTIFICATION (Name and Grade) NEPA Program Manager George Komine, BWT 1-7		
19a. SIGNATURE <i>George Komine</i>		19b. DATE 26 June 06

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**APPENDIX E**

**NATURAL RESOURCES SURVEY**



**Natural Resource Survey  
of the  
Kadena Base Exchange Expansion Project Area  
Kadena Air Base, Okinawa Prefecture, Japan**

**Prepared For:**  
Scientific Applications International Corporation  
1130 Eglin Parkway  
Shalimar, Florida 32579



Sub-Contract No. 4400141642

GANDA Job Number. J9001

**Prepared By:**  
Jason Minton, MSc  
  
Garcia and Associates  
1512 Franklin Street, Suite 100  
Oakland, California 94612



May 23, 2007



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### 1. Introduction

At the request of Science Application International Corporation (SAIC), Garcia and Associates has completed reconnaissance-level surveys for natural resources and threatened and endangered species at the project area of the proposed Base Exchange expansion at Kadena Air Base (KAB), Okinawa, Japan. These surveys are required by KAB to support environmental analysis in compliance with United States Department of Defense Japanese Environmental Governmental Standards (JEGS) Criterion “13-3.6 Natural Resources Site Review.”

Biological surveys are conducted in order to locate and document threatened and endangered species as identified in: JEGS Chapter 13, the Integrated Natural Resource Management Plan for KAB, the Threatened Wildlife of Japan (Environment Agency 2000a,b,c; Ministry of Environment 2002, 2006), and the Threatened Wildlife of Okinawa (Okinawa Prefecture 1996, 2005).

The goal of this investigation was to locate threatened and endangered plants and animals or their nests or burrows.

### 2. Personnel and Project Schedule

Natural resource surveys for wildlife and plants were conducted on February 26, 2007. All personnel employed for the field surveys on this project have experience and expertise in their field of study within Okinawa Prefecture, Japan.

Natural resources personnel included Mr. Yoshio Suzuki, botanist (Institute of Tropical Plants and Environment), Mr. Masaaki Kimura, wildlife biologist/entomologist (Ga-Show Consulting), and Mrs. Yoshiko Kimura, assistant entomologist (Ga-Show Consulting).

Project Manager Jason Minton, MSc, provided overall project management and report compilation and production. Carole Garcia, MA, provided technical editing and QA/QC. Cassidy DeBaker provided Geographic Information Systems (GIS) support.

### 3. Project Location and Description

The proposed project area is located near Kuter Avenue, at the current site of the Kadena Base Exchange (BX). A majority of the proposed project area has been previously developed as the current Base Exchange and its associated parking facilities. A portion of the project area located west of Seville Avenue is composed of a wooded ravine and a watercourse.

The topography of the ravine includes areas with steep slopes and cliffs, some areas of exposed limestone, and flat creek bottoms at the base of the ravines. Several areas of exposed limestone were located in the ravine. A road berm interrupts the natural topography of the ravine, resulting in a division between two portions. For ease of

reference in this report, the portions of the ravine are referred to as the “northwest” and the “southeast” sections (Figure 1).

#### 4. Methods

Reconnaissance-level wildlife and botanical surveys were conducted to confirm the presence of special status species within the survey sites as required under JEGS Chapter 13 and in the Integrated Natural Resource Management Plan (INRMP) for KAB. Prior to initiation of site surveys, aerial photos were evaluated to determine the most suitable areas of habitat to survey at each site. Developed areas within the project area were excluded from the survey.

Suitable habitat was identified in two sections of wooded ravine located west of Seville Avenue. The survey area for natural resources was confined to this natural area. The survey area was extended outside the proposed project area limits in the northwest section of the ravine due to the continuous habitat existing along the watercourse. Surveyors did not follow delineated transects, but did complete a comprehensive walking survey of the two sections of the ravine.

The status of species identified was reviewed from several different sources, including the KAB INRMP, lists available in the 1<sup>st</sup> and 2<sup>nd</sup> Editions of the Threatened Wildlife of Okinawa (Okinawa 1996, 2005), lists available in the Threatened Wildlife of Japan – Red Data Books (Environment Agency 2000a,b,c; Ministry of Environment 2002, 2006), and the searchable website based on the national Red Data Books ([www.biodic.go.jp/english/rdb/rdb\\_do\\_e.html](http://www.biodic.go.jp/english/rdb/rdb_do_e.html)). The regulatory status of species identified during the surveys is located in the results section of this report.

#### 5. Results and Discussion

##### 5.1. General Observations

The survey resulted in relatively few wildlife observations relative to what could be expected under optimum habitat conditions in central Okinawa. A comprehensive list of animal species observed is provided in Appendix A. The relatively few wildlife observations may be attributed to the small area size of the habitat fragment represented by the ravine, the homogeneity of the vegetation, and the fact that the survey was not conducted during the prime season for wildlife observations. The weather conditions during the survey were optimum, given the season, and the effectiveness of the survey was satisfactory.

The survey area was predominantly vegetated with a depauperate broadleaf evergreen forest community. A comprehensive list of plant species observed is provided in Appendix B. Areas of steep slopes and cliffs were predominantly vegetated with *Macaranga tanarius*, *Psychotria manillensis*, and *Cinnamomum japonicum*. This community is likely to have replaced a plant community dominated by *Machilus thunbergii*, which would be the natural climax community for this type of topographic

area in Okinawa. *Machilus thunbergii* is a valuable timber tree, and was likely to have been harvested from this area in the past.

The predominant vegetation of the flat creek bottoms was *Bischofia javanica*, which is a typical climax forest type along watercourses and other low lying wooded areas on Okinawa Island.

Forest edge habitat, where it interfaced with ornamental vegetation and other development, was dominated by *Elaeocarpus sylvestris*, *Rhus succedanea*, *Ficus microcarpa* and *Asplenium nidua*.

## 5.2. Plant Survey Results

The botanical survey identified no special status plant species. A comprehensive list of plant species identified during the survey is included in Appendix B.

The locations of six *Bischofia javanica* trees were noted due to the large size of each individual specimen (Figure 1, Table 1). There is no protective status granted to these trees by any regulatory agency.

Photographs of the trees identified during the survey are located in Appendix C of this report. Three of those *B. javanica* trees were located within the project area along the creek channel at the bottom of the southeast portion of the ravine. Three additional *B. javanica* of large diameter were located immediately outside the project area boundary, at the north end of the northwest portion of the ravine.

**Table 1. Observations of large trees located within the survey area. Photographs are provided in Appendix C.**

Scientific Name	Japanese Name	Status	Trunk Circumference (cm)	DBH (cm)	Height (m)	Map Point (Fig. 1)
<i>Bischofia javanica</i>	アカギ	Large diameter	420	134	12	P1
<i>Bischofia javanica</i>	アカギ	Large diameter	360	115	11	P2
<i>Bischofia javanica</i>	アカギ	Large diameter	310	99	11	P3
<i>Bischofia javanica</i>	アカギ	Large diameter	300	96	12	P4
<i>Bischofia javanica</i>	アカギ	Large diameter	270	86	12	P5
<i>Bischofia javanica</i>	アカギ	Large diameter	290	92	11	P6

The trees identified as P1 and P2 are the largest, and therefore the oldest, specimens encountered during the surveys. These trees could be considered for removal and transplantation to another site, because the species is resilient to severe pruning. Moving the trees during the flowering and fruiting season should be avoided. The most appropriate time to transplant the trees would be between February and June.

*Bischofia javanica* is a typical Okinawan tree in streamside habitats, and can quickly grow to large size in natural areas. However, it is a very useful tree for timber and other uses, and large specimens are not often found in urban or suburban areas. For example, there is a *B. javanica* tree in Naha City that has been nationally designated as a landmark, and another specimen in Urasoe City of Okinawa which has been locally designated. The trees identified as P1 and P2 are of lesser diameter than those landmarks, but the occurrence of such large specimens in an urbanized area is unusual. The trees may also be associated with nearby cemetery areas, as they have historically been nurtured near such sites for a variety of purposes.

Transplantation of the trees is not required by regulation. If the trees were to be transplanted, it would be in consideration of the age, large diameter, and the possible cultural association with nearby potential cemetery sites.



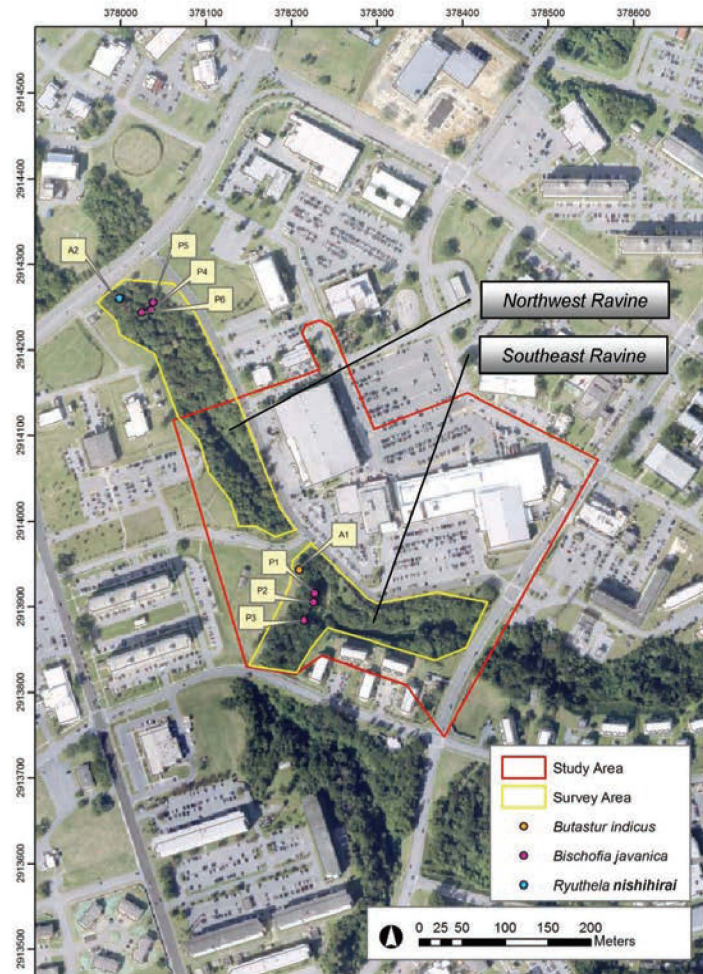


Figure 1. Proposed project area of the Kadena Base Exchange expansion project, the survey area located west of Seville Avenue, and the locations of trees and wildlife identified during the surveys.

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### 5.3. Wildlife Survey Results

The wildlife survey resulted in two observations of special status wildlife species within the survey area (Figure 1, Table 2). A single gray-faced buzzard eagle (*Butastur indicus*) was observed within the project area, and a colony of Okinawan Kimura's trap door spiders (*Ryuthela nishihirai*) was observed outside the northwest boundary of the project area.

**Table 2. Observations of special status wildlife species within the survey area.**

Scientific Name	Japanese Name	Status	Map Point (Fig. 1)
<i>Butastur indicus</i>	サシノバ	Vulnerable	A1
<i>Ryuthela nishihirai</i>	オキナワキムラグモ	Vulnerable	A2

#### 5.3.1. Gray-faced Buzzard Eagle (*Butastur indicus*)

A single observation of a wintering or migratory gray-faced buzzard eagle (*Butastur indicus*) was confirmed within the project area, in the southeast section of the ravine (Figure 1, Table 2). The bird was perched in a tree near the top of the ravine adjacent to the meadow that lies to the west.

Okinawa is within the wintering range of the gray-faced buzzard eagle. That range extends from the Ryukyu Islands through Southeast Asia to Indonesia. Individuals may winter in Okinawa, or they may be observed during migration. The species is not recognized as a breeding species in Okinawa Prefecture. The species typically breeds on the main islands of Japan, from Kyushu through Honshu, and on the Asian mainland. The species is listed as vulnerable in the revised Threatened Wildlife of Japan (Ministry of Environment 2006).

Due to the status of the gray-faced buzzard eagle as a winter visitor and migrant in Okinawa Prefecture, we do not see the necessity to recommend any avoidance, minimization or mitigation measures for the proposed construction project.

#### 5.3.2. Okinawan Kimura's trap door spider (*Ryuthela nishihirai*)

The Okinawan Kimura's trap door spider is listed as vulnerable in the Threatened Wildlife of Japan (Ministry of Environment 2002). This species of small trap door spider inhabits vertical embankments, where it lives semi-colonially and constructs its tunnels from which to ambush prey (Figure 2). The species was confirmed at one location within the northwest portion of the ravine, but outside the designated project area (Figure 1).

Due to the location of the colony, no disturbance is expected from construction, and no further recommendations are proposed.

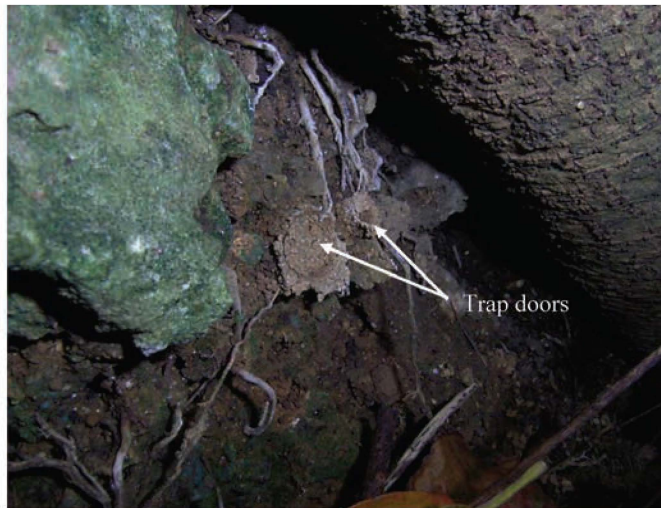


Figure 2. A typical entrance of an Okinawan Kimura's trap door spider tunnel.

## 6. Conclusion

The botanical and wildlife surveys confirmed the presence of a colony of Okinawan Kimura's trap door spiders located at the northern end of the ravine outside the project area (Figure 1). A wintering or migratory gray-faced buzzard eagle was observed within the project area along the western edge of the ravine.

The two special status wildlife species identified during the survey do not require additional consideration in the project planning process. The gray-faced buzzard eagle is a wintering or migratory individual that will not be significantly impacted by the proposed project's activities. The colony of Okinawan Kimura's trap door spiders is not likely to be disturbed because it is outside the proposed project boundaries.

One limiting factor of the results should be noted: due to the project schedule, surveys were not conducted during the optimal season for identifying wildlife or plants. Considering the generally depauperate condition of the vegetation community, however, the results of the survey are considered to satisfactorily represent the actual conditions at the site.



## 7. References

Okinawa Prefecture. 1996. Threatened Wildlife in Okinawa (RDB), 1<sup>st</sup> Edition. Okinawa Prefectural Government.

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**Appendix A. List of incidental wildlife species observed.***(Excerpted from field survey report)*

Japanese name	Order	Family	Scientific name
<b>MAMMALS</b>			
ジャワマンゲース	CARNIVORA	Herpestidae	<i>Herpestes javanicus</i>
<b>BIRDS</b>			
ササゴイ	CICONIIFORMES	Ardeidae	<i>Butorides striatus</i>
サシバ	FALCONIFORMES	Accipitridae	<i>Butastur indicus</i>
キジバト	COLUMBIFORMES	Columbidae	<i>Streptopelia orientalis</i>
リュウキュウツバメ	PASSERIFORMES	Hirundinidae	<i>Hirundo tahitica</i>
ヒヨドリ	PASSERIFORMES	Pycnonotidae	<i>Hypsipetes amaurotis</i>
シロハラ	PASSERIFORMES	Muscicapidae	<i>Turdus pallidus</i>
ウグイス	PASSERIFORMES	Muscicapidae	<i>Cettia diphone</i>
シジュウカラ	PASSERIFORMES	Paridae	<i>Parus major</i>
メジロ	PASSERIFORMES	Zosteropidae	<i>Zosterops japonica</i>
<b>REPTILES</b>			
ミナミヤモリ	SQUAMATA	Gekkonidae	<i>Gekko hokouensis</i>
<b>AMPHIBIANS</b>			
リュウキュウカジガエル	SALIENTIA	Rhacophoridae	<i>Buergeria japonica</i>
<b>INSECTS</b>			
オガサワラゴキブリ	BLATTARIA	Pycnoscelidae	<i>Pycnoscelus surinamensis</i>
ハラビロカマキリ	MANTODEA	Mantidae	<i>Hierodula patellifera</i>
オキナワヤマトシロアリ	ISOPTERA	Rhinotermitidae	<i>Reticulitermes okinawanus</i>
ハマベハサミムシ	DERMAPTERA	Anisolabididae	<i>Anisolabis maritima</i>
ホオズキカメムシ	HETEROPTERA	Coreidae	<i>Acanthocoris sordidus</i>
アカアシハラナガツチバチ	HYMENOPTERA	Scoliidae	<i>Megacampsomeris mojiensis</i>
アシジロヒラフシアリ	HYMENOPTERA	Formicidae	<i>Technomyrmex albipes</i>
コガタスズメバチ	HYMENOPTERA	Vespidae	<i>Vespa analis</i>
セイヨウミツバチ	HYMENOPTERA	Apidae	<i>Apis mellifera</i>

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Japanese name	Order	Family	Scientific name
ホソヒラタアブ	DIPTERA	Syrphidae	<i>Episyrphus</i> <i>balteatus</i>
イヌビワオオハマキモドキ	LEPIDOPTERA	Choreutidae	<i>Saptha divitiosa</i>
シロオビアゲハ	LEPIDOPTERA	Papilionidae	<i>Papilio polytes</i>
ナミエシロチョウ	LEPIDOPTERA	Pieridae	<i>Appias paulina</i>
モンシロチョウ	LEPIDOPTERA	Pieridae	<i>Artogeia rapae</i>
アマミウラナミシジミ	LEPIDOPTERA	Lycaenidae	<i>Nacaduba kurava</i>
ヤマトシジミ	LEPIDOPTERA	Lycaenidae	<i>Pseudozizeeria</i> <i>maha</i>
イシガケチョウ	LEPIDOPTERA	Nymphalidae	<i>Cyrestis</i> <i>thyodamas</i>
ルリタテハ	LEPIDOPTERA	Nymphalidae	<i>Kaniska canace</i>
ウスイロコノマチョウ	LEPIDOPTERA	Satyridae	<i>Melanitis leda</i>
オオトモエ	LEPIDOPTERA	Noctuidae	<i>Erebus</i> <i>ephesperis</i>
<b>SPIDERS</b>			
オキナワキムラグモ	ARANEAE	Liphistiidae	<i>Ryuthela nishihirai</i>
<b>LAND SNAILS</b>			
オキナワヤマタニシ	MESOGASTROPODA	Cyclophoridae	<i>Cyclophorus</i> <i>turgidus turgidus</i>
アフリカマイマイ	STYLOMMATOPHORA	Achatinidae	<i>Achatina fulica</i>
オオカサマイマイ	STYLOMMATOPHORA	Zonitidae	<i>Videnoida</i> <i>horiomphala</i>
シュリマイマイ	STYLOMMATOPHORA	Camaenidae	<i>Satsuma</i> <i>mercatoria</i>
オキナワウスカワマイマイ	STYLOMMATOPHORA	Bradybaenidae	<i>Acusta despecta</i>

**Appendix B. List of incidental plant species observed***(Excerpted from field survey report)*

Japanese name	Family	Scientific name
ナガバカニクサ	Schizaeaceae	<i>Lygodium japonicum</i>
コシダ	Gleicheniaceae	<i>Dicranopteris linearis</i>
マツザカシダ	Pteridaceae	<i>Pteris cretica</i> var. <i>albolineata</i>
ヤンバルタマシダ	Davalliaceae	<i>Nephrolepis hirsutula</i>
タマシダ	Davalliaceae	<i>Nephrolepis auriculata</i>
オニヤブソテツ	Aspidiaceae	<i>Cyrtomium falcatum</i>
ヘラシダ	Aspidiaceae	<i>Diplazium subsinuatum</i>
ホザキカナワラビ	Aspidiaceae	<i>Arachnides dimorphophylla</i>
イヌタマシダ	Aspidiaceae	<i>Dryopteris hayatae</i>
ケホシダ	Aspidiaceae	<i>Thelypteris parasitica</i>
ヒリュウシダ	Blechnaceae	<i>Blechnum orientale</i>
シマオオタニワタリ	Aspleniaceae	<i>Asplenium nidua</i>
オオタニワタリ	Aspleniaceae	<i>Asplenium antiquum</i>
イヌマキ	Podocarpaceae	<i>Podocarpus macrophyllus</i>
ススキ	Gramineae	<i>Miscanthus sinensis</i>
イヌシバ	Gramineae	<i>Stenotaphrum secundatum</i>
エダウチヂミザサ	Gramineae	<i>Opismenus compositus</i>
コウライシバ	Gramineae	<i>Zoysia matrella</i>
イヌコウジュ	Gramineae	<i>Mosla punctulata</i>
ハチジョウススキ	Gramineae	<i>Miscanthus Condensatus</i>
ダンチク	Gramineae	<i>Arundo donax</i> L. var. <i>donax</i>
マダケ	Gramineae	<i>Phyllostachys bambusoides</i>
シュロガヤツリ	Cyperaceae	<i>Cyperus alternifolius</i> L. var. <i>obtusangulus</i>
シンノウヤシ	Palmae	<i>Phoenix roebelenii</i>
トックリヤシモドキ	Palmae	<i>Mascarena verschaffeltii</i>
ダイオウヤシ	Palmae	<i>Roystonea regia</i>
クロツグ	Palmae	<i>Arenga engleri</i>
クジャクヤシ	Palmae	<i>Caryota urens</i>
クワズイモ	Araceae	<i>Alocasia odora</i>
オウゴンカズラ	Araceae	<i>Epipremnum aureum</i>
ヤバネイモ	Areceae	<i>Xanthosoma sagittifolium</i>
トウツルモドキ	Flagellariaceae	<i>Flagellaria indica</i>
キキョウラン	Liliaceae	<i>Dianella ensifolia</i>
サツマサンキライ	Liliaceae	<i>Smilax bracteata</i>
オキナワサルトリイバラ	Liliaceae	<i>Smilax china</i>
センネンボク	Agavaceae	<i>Dracaena surculosa</i>
シマバナナ	Musaceae	<i>Musa X paradisiensis</i>
ゲットウ	Zingiberaceae	<i>Alpinia speciosa</i>
アオノクマタケラン	Zingiberaceae	<i>Alpinia intermedia</i>

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Japanese name	Family	Scientific name
トキワギョリュウ	Casuarinaceae	<i>Casuarina equisetifolia</i>
フウトウカズラ	Piperaceae	<i>Piper kadsura</i>
リュウキュウエノキ	Ulmaceae	<i>Celtis boniensesis</i>
シマグワ	Moraceae	<i>Morus australis</i>
オオバイヌビワ	Moraceae	<i>Ficus septica</i>
イタビカズラ	Moraceae	<i>Ficus sarmentosa</i>
オオイタビカズラ	Moraceae	<i>Ficus pumila</i>
ガジュマル	Moraceae	<i>Ficus microcarpa</i>
イヌビワ	Moraceae	<i>Ficus erecta</i>
ノカラムシ	Urticaeae	<i>Boehmeria nivea</i> L. <i>Gaudich.f.viridula</i>
ハルタデ	Polygonaceae	<i>Polygonum persicaria</i>
スイバ	Polygonaceae	<i>Rumex acetosa</i>
ギシギシ	Polygonaceae	<i>Rumex japonicus</i>
リュウキュウボタンヅル	Ranunculaceae	<i>Clematis grata</i> var. <i>ryukuiensis</i>
アオツツラフジ	Menispermaceae	<i>Cocculus trilobus</i>
ビナンカズラ	Magnoliaceae	<i>Kadsura japonica</i>
シキミ	Illiciaceae	<i>Illicium anisatum</i> L. var. <i>anisatum</i>
タブノキ	Lauraceae	<i>Machilus thunbergii</i>
シロダモ	Lauraceae	<i>Neolitsea sericea</i>
シバニツケイ	Lauraceae	<i>Cinnamomum doederleinii</i>
ヤブニツケイ	Lauraceae	<i>Cinnamomum japonicum</i>
ホソバタブ	Lauraceae	<i>Machilus japonica</i>
トベラ	Pittosporaceae	<i>Pittosporum tobira</i>
ホウロクイチゴ	Rosaceae	<i>Rubus sieboldii</i>
ヘビイチゴ	Rosaceae	<i>Duchesnea indica</i>
ホソバシャリンバイ	Rosaceae	<i>Rhaphiolepis umbellata</i> thunb. <i>Makino</i> var. <i>liukiensis</i>
ギンネム	Leguminosae	<i>Leucaena leucocephala</i>
ソウシジュ	Leguminosae	<i>Acacia confusa</i>
ミヤコグサ	Leguminosae	<i>Lotus corniculatus</i> L.var. <i>japonicus</i>
シロツメクサ	Leguminosae	<i>Trifolium repens</i>
ヤエヤマシタン	Leguminosae	<i>Pterocarpus indicus</i>
アメリカフウロ	Geraniaceae	<i>Geranium carolinianum</i>
カタバミ	Oxalidaceae	<i>Oxalis corniculata</i>
ゲッキツ	Rutaceae	<i>Murraya paniculata</i>
ヒラミレモン	Rutaceae	<i>Citrus depressa</i>
オオバギ	Euphorbiaceae	<i>Macaranga tanarius</i>
アカギ	Euphorbiaceae	<i>Bischofia javanica</i>
カキバカンコノキ	Euphorbiaceae	<i>Glochidion zeylanicum</i>
アカメガシワ	Euphorbiaceae	<i>Mallotus japonicus</i>
クスノハガシワ	Euphorbiaceae	<i>Mallotus philippensis</i>

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Japanese name	Family	Scientific name
オキナワツゲ	Buxaceae	<i>Buxus liukiensis</i>
ハゼノキ	Anacardiaceae	<i>Rhus succedanea</i>
ツルウメモドキ	Celastraceae	<i>Celastrus punctatus</i>
マサキ	Celastraceae	<i>Euonymus japonicus</i>
アマミツタ	Vitaceae	<i>Parthenocissus heterophylla</i>
エビヅル	Vitaceae	<i>Vitis ficifolia</i>
ノブドウ	Vitaceae	<i>Ampelopsis brevipedunculata</i>
ホルトノキ	Elaeocarpaceae	<i>Elaeocarpus sylvestris</i>
キンゴジカ	Malvaceae	<i>Sida rhombifolia</i> <i>subsp. rhombifolia</i>
ヒサカキ	Theaceae	<i>Eurya japonica</i>
フクギ	Guttiferae	<i>Garcinia subelliptica</i>
リュウキュウコスミレ	Violaceae	<i>Viola pseudojaponica</i>
マルバグミ	Elaeagnaceae	<i>Elaeagnus macrophylla</i>
ツルグミ	Elaeagnaceae	<i>Elaeagnus glabra</i>
テンニンカ	Myrtaceae	<i>Rhodomyrtus tomentosa</i>
ノボタン	Melastomataceae	<i>Melastoma candidum</i>
フカノキ	Araliaceae	<i>Schefflera octophylla</i>
ウド	Araliaceae	<i>Aralia cordata</i>
チドメグサ	Umbelliferae	<i>Hydrocotyle sibthorpioides</i>
ツボクサ	Umbelliferae	<i>Centella asiatica</i>
ギーマ	Ericaceae	<i>Vaccinium wrightii</i>
シマイゼンリョウ	Myrsinaceae	<i>Maesa tenera</i>
タイミンタチバナ	Myrsinaceae	<i>Myrsine seguinii</i>
ルリハコベ	Primulaceae	<i>Anagallis arvensis</i> L. f. <i>caerulea</i>
リュウキュウテイカズラ	Apocynaceae	<i>Trachelospermum foetidum</i>
サカキカズラ	Apocynaceae	<i>Anodendron affine</i>
ダイコンドラ	Convolvulaceae	<i>Dichondra micrantha</i>
ベニバナクサギ	Verbenaceae	<i>Clerodendrum bungei</i>
ヤブチョロギ	Labiatae	<i>Stachys arvensis</i>
ヒメセンナリホウズキ	Solanaceae	<i>Physalis minima</i>
ヤナギバルイラソウ	Acanthaceae	<i>Ruellia brittoniana</i>
シラタマカズラ	Rubiaceae	<i>Psychotris serpens</i>
ナガミボチョウジ	Rubiaceae	<i>Psychotria manillensis</i>
ボチョウジ	Rubiaceae	<i>Psychotria rubra</i>
マルバルリミノキ	Rubiaceae	<i>Lasianthus wallichii</i>
オオバルリミノキ	Rubiaceae	<i>Lasianthus trichophlebus</i>
ヤエムグラ	Rubiaceae	<i>Galium aparine</i>
サンダンカ	Rubiaceae	<i>Ixora chinensis</i>
サンゴジュ	Caprifoliaceae	<i>Viburnum awabuki</i>
リュウキュウスズメウリ	Cucurbitaceae	<i>Trichosanthes miyagii</i>
シロノセンダングサ	Compositae	<i>Bidens pilosa</i> var. <i>radiata</i>
オニノゲシ	Compositae	<i>Sonchus asper</i>
コケセンボンギクモドキ	Compositae	<i>Lagenophora</i> sp.

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Japanese name	Family	Scientific name
ウスベニニガナ	Compositae	<i>Emilia sonchifolia</i>
セイヨウタンポポ	Compositae	<i>Taraxacum officinale</i>
ベニバナボロギク	Compositae	<i>Crassocephalum crepidioides</i>

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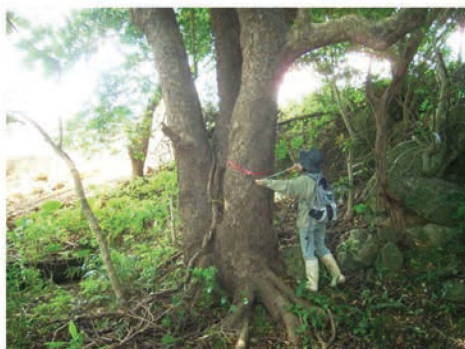


Appendix C. Photographs of *Bischofia javanica*

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*Bischofia javanica* labeled P1.



*Bischofia javanica* labeled P2.



*Bischofia javanica* labeled P3.

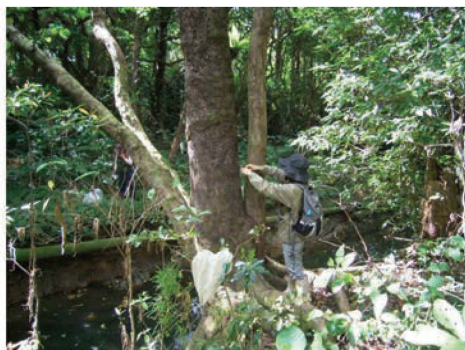
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*Bischofia javanica* labeled P4.



*Bischofia javanica* labeled P5.



*Bischofia javanica* labeled P6.

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